A CATECHISM OF AGRICULTURE

THOMAS CLARK ATKESON

"Lawnvale," the former home of T. C. Atkeson in the Kanawha Valley, Putnam County, West Virginia.

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By

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ILLUSTRATED

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The title to this little volume was originally suggested by my wife, Cordelia Meek Atkeson, to whom it is affectionately dedicated.

The Author.

PREFACE TO FOURTH EDITION

This catechism was originally written for a school journal by the writer and Prof. D. W. Working, in the hope that it would promote accurate knowledge and clear thinking concerning some of the elementary facts and principles of agriculture among the school teachers of the state. No effort was made to ask and answer all the questions likely to occur to teachers, but to include only those that seemed to be necessary to make a fairly comprehensive treatment of the general field of elementary agriculture.

As agriculture was just becoming a common-school subject, and as very few teachers in the state had been taught agriculture, it was necessary to make the treatment as simple and direct as possible. At the same time, it was necessary to remember that many of these teachers were practical farmers who would test the questions and answers from the standpoint of the best farm experience in the state. It was important, also, that the catechism be made to harmonize with the best of modern agricultural knowledge, because it was sure to fall into the hands of teachers trained in the best agricultural schools and colleges in the country.

After being printed in the school journal, a small

edition of the catechism was privately printed by the authors. This edition was freely distributed as long as it lasted; and in the fall of 1909 the extension department of the college of agriculture issued a second edition of 2,500 copies. The demand for this edition was so great that it was practically exhausted by the first of February, 1910. The demand continuing, it seemed advisable to make a third printing; for which purpose the entire pamphlet was carefully revised, question by question and answer by answer, with the result that many changes and additions were made. Of this third edition 5,000 copies were printed and distributed to the teachers and farmers of the state. The demand has continued to such an extent that it has seemed expedient to issue this fourth edition in an enlarged and more permanent form.

Prof. D. W. Working, who was associated with me in preparing the earlier editions of this catechism for the printer was at that time superintendent of agricultural extension at West Virginia University, but resigned in June, 1911, to accept a position with the farm management investigations, United States Department of Agriculture, with headquarters at Denver, Colorado. Pleasant as our association was, our lives having drifted apart, he has kindly agreed that I may use the product of our co-operative work contained in the third edition in the preparation of this enlarged and more perma-

nent fourth edition. Many additions and revisions have been made and Section IV, Farm Crop Management; Section VI, Dairy Management; and Section VII, Farm Management, are entirely new. Illustrations appear in this edition for the first time and add much to its attractiveness. Without any thought of claiming perfection or completeness for this little volume, I venture to express the hope that it may be found of value to teachers and country school pupils, and to busy farmers generally.

T. C. ATKESON.

Morgantown, W. Va., October 15, 1912.

CONTENTS

A Catechism of Agriculture

I. SCOPE OF THE SUBJECT

AGRICULTURE DEFINED

1. What is agriculture?

No single definition can be framed to include all that is implied by the term agriculture; for agriculture is an art or trade which one man learns from his father and his father's neighbors; it is a business which another man builds up by adapting the general principles of business operations to the management of soil, machinery, plants, animals, and men in producing plants and animals and their products for sale; and it is a science or body of related facts and principles which a third man so uses that the art and the business of farming may profit thereby.

2. What is the art of agriculture?

The art of agriculture, or farming, includes the tilling of the soil, the raising of farm crops common to a particular region, and the rearing, feeding, and using of farm animals.

3. What is the business of agriculture?

The business of agriculture, or farming, includes the purchase of supplies and equipment, the employment and management of men, the planning of the farm, and the orderly conduct of its operations, the selling of its products, and the keeping of books of record and account; agricultural economics.

4. What is the science of agriculture?

The science of agriculture, or farming, is the body of systematized knowledge and principles which explains the processes of soil management, and plant and animal production, improvement, and nutrition.

THE KNOWLEDGE OF AGRICULTURE

5. Who should know the art of agriculture?

In order to succeed at all, every man who engages in farming or farm management must know at least the essentials of the art of agriculture; he needs to have the familiar knowledge and the skill in practice which are acquired most readily by the boy who grows up on the farm and works with his father and brothers.

6. Who should know the business of agriculture?

Every farmer who employs men and uses machinery must have the business ability that enables a man to use the knowledge and the labor of others in carrying out his plans. Even the small farmer needs to have some business ability, but the manager of a large farm must be a real business man, because he is engaged in buying and using supplies and machinery, in employing and managing men, and in selling the output of the farm; he is a dealer to a greater degree than he is a worker with his hands.

7. Who should know the science of agriculture?

In order to give sound instruction, the teacher must know at least the elements of the science of

agriculture. As this science explains the meaning and the movement of water and air in the soil and the processes of life in soil, plant, and animal, a working knowledge of its most important facts and principles is of great advantage to every person who works with soils, plants, or animals.

AGRICULTURE AND OTHER SCIENCES

8. How does agriculture differ from geology, physics, and chemistry?

Agriculture takes the results of the investigations of these sciences and applies them in the management of the soil for the purpose of producing plants.

9. How does agriculture differ from botany and bacteriology?

It takes the results of the investigations of these sciences and applies them in the management of plants and of plant and animal products.

10. How does agriculture differ from zoology, physiology, and entomology?

It takes the results of the investigations of these sciences and applies them in the breeding and management of animals and in the protection of plants and animals against diseases and injurious insects.

AGRICULTURAL RELATIONSHIPS

11. What is the relation of plants and animals to the soil?

A considerable part of every productive soil is composed of the remains of plants and animals and

owes its condition of fertility largely to the work of plants and animals. Few, if any, of the higher plants can grow in a soil that lacks vegetable or animal matter.

12. What is the relation of the soil to living plants?

Most plants grow out of the soil which supports them in place and furnishes them an important part of the food that sustains them. Without this support and sustenance plants could not grow.

13. What is the relation of plants to animals?

All of the higher animals live on plants and plant products or on other animals that are mainly or entirely sustained by vegetable matter. Plants can draw their food supplies from the soil and the air, but animals cannot.

II. SOIL MANAGEMENT

THE SOIL

14. What is the soil?

The soil is the surface layer of the earth down to solid rock. Usually we think of the soil as being the few inches of earth reached by the plow.

15. What name is given to the layer of earth just below the part reached by the plow?

It is called the subsoil.

16. How does the subsoil differ from the surface soil?

It contains less vegetable matter, and is therefore lighter in color; also, it is generally firmer in texture and less open to air and water.

17. How was the soil formed?

By the dissolving and grinding power of water and the crumbling effect of heat and cold, the original rock-surface of the earth was broken up. Later, the work of burrowing animals, insects, and earthworms and the growth of plant roots, providing for the freer entrance of air and water, continued the breaking-up process; and the death and decay of these living things added to the soil the matter called humus. The work of bacteria (living things too small to be seen without a microscope) also helped to change the rock-fragments into more productive soil.

18. How are soils classified?

According to their principal constituents, such as sand, clay, loam or humus.

19. What is a sandy soil?

A sandy soil is one composed in large part of sand. This sand may be coarse or fine and mixed with gravel; and always it contains a certain amount of material finer than sand, as silt and clay and fine vegetable mold.

20. What is a clay soil?

A clay soil is one composed in large part of the fine, sticky, plastic material known as clay. It may contain a considerable portion of gravel, sand, and humus.

21. What is a loam or humus soil?

A loam or humus soil is one containing a large percentage of decaying vegetable and animal matter mixed with fine sand and clay, which form the bulk of the soil.

22. What is a fertile soil?

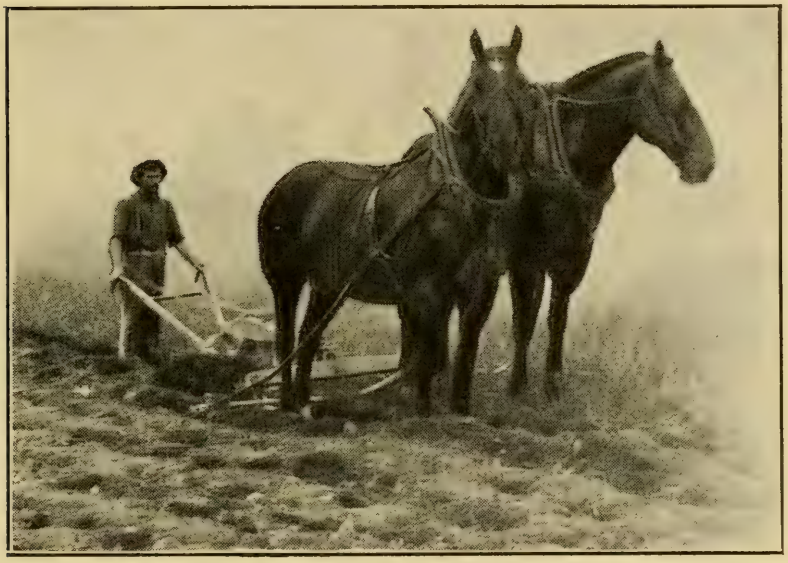
Any soil that is in condition to produce good crops with ordinary tillage. All fertile soils contain vegetable and animal matter in a partly decayed condition in addition to the necessary chemical elements.

23. Upon what does the fertility of the soil depend?

Mainly upon its mechanical condition, the availability of its plant-food elements, and the presence and activity of germ or bacterial life.

24. What is meant by the mechanical condition of the soil?

The mechanical condition of a soil is its physical state, or the character indicated by what farmers describe as hard, heavy, light, stiff, mellow, warm, cold, damp, wet, peaty, clayey, sandy, or loamy. We ordinarily judge the mechanical condition of a soil by its looks, its "feel" in the hand or under foot, and the way it is affected by tillage implements.



Fall plowing on an up-to-date grain farm.

25. What is availability?

Plant food is said to be available when it is dissolved or soluble in the soil-water, in which condition only can it be taken up by plant roots.

26. What is meant by the chemical composition of the soil?

The chemical composition of a soil is its make-up

with regard to the numerous mineral and other elements of which it is composed, only a few of which are necessary to plant growth.

27. What are the bacterial properties of the soil?

All cultivated soils are teeming with bacteria, whose agricultural function it is to aid in supplying plants with necessary food. Without these bacteria no higher plants can grow.

28. How may the mechanical condition of the soil be improved?

By all of the operations of cultivation; by drainage and irrigation; by the addition of decaying vegetable matter; by adding sand to clay and clay to sand; and by the application of lime, which makes a clay soil more open and a sandy soil more compact.

29. How may the availability of the plant food of the soil be increased?

By the improvement of the mechanical condition of the soil, the rotation of crops, and the use of cover crops, all of which promote chemical action resulting in the breaking down of insoluble soil compounds.

30. What is rotation of crops

By rotation is meant the systematic succession of crops through a definite series of years—as the growing of corn followed by oats, wheat, and clover with timothy for the last two years of a five-year period.

31. What is a cover crop?

A cover crop is one grown between regular crops for the purpose of protecting the land against washing and to add humus to the soil—as by the sowing of rye or cowpeas in the late summer or early fall to be plowed under in the spring.

32. How may the germ life in the soil be stimulated?

By the addition of decaying vegetable and animal

A successful lime distributor in operation.

matter, by the use of lime, by drainage, and by thorough tillage.

ELEMENTS AND COMPOUNDS

33. What is an element?

An element is a simple substance, such as iron or gold, or the oxygen or nitrogen of the air.

34. What are the essential plant-food elements?

Carbon, oxygen, hydrogen, nitrogen, phosphorus,

potassium, calcium, sulphur, iron, and magnesium.

35. How are these elements supplied to the plant?

The first in the form of the carbonic acid gas (carbon dioxide) which is mingled with the air; the others in the form of compounds dissolved in the soil-water.

36. What is a chemical compound?

A compound is a substance composed of two or more elements chemically combined.

37. Are soils likely to be lacking in any of the plant-food elements?

Many soils are or may become deficient in available nitrogen, potassium, or phosphorus.

38. How may this lack be supplied?

By the use of manure or fertilizer and by growing leguminous crops.

MANURES AND FERTILIZERS

39. What is a manure or fertilizer?

Any substance which may supply the soil with available plant food, especially nitrogen, potassium, or phosphorus.

40. What is a commercial fertilizer?

A fertilizing material which is bought and sold on the market.

41. What is a complete fertilizer?

Any fertilizing substance which contains available nitrogen, potassium, and phosphorus.

42. By what names are these fertilizing elements commercially known?

Nitrogen, potash, and phosphoric acid.

43. How may the purchaser of a commercial fertilizer know that he is getting what he buys?

By examining the tag attached to each package. This tag, under the laws of nearly all of the states, must guarantee the amount of nitrogen, potash, and phosphoric acid which the fertilizer contains; and the manufacturer may be heavily fined for selling an article containing less than the guaranteed percentage of any fertilizing element.

44. What information does the tag give?

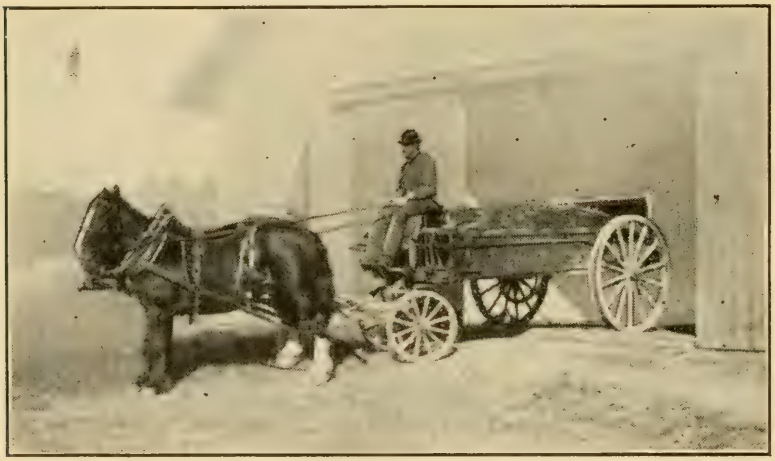
The tag guarantees the percentage (pounds per hundred) of nitrogen, potash, and phosphorus contained by the fertilizer.

45. How may a purchaser know the market value of a commercial fertilizer?

The prices of nitrogen, potash, and phosphorus vary a little from year to year; but usually nitrogen costs less than twenty cents a pound, and potash and phosphorus each less than five cents. Therefore, if the per cent of nitrogen be multiplied by 20 and the per cent of potash and phosphorus be multiplied by 5, the sum of the results will be about the value in cents of a hundred pounds of the fertilizer. Thus, if a fertilizer contains two per cent of nitrogen, four per cent of potash, and ten per cent of phosphoric acid, its approximate value can be found as follows:

$$
\begin{aligned}
2 \times 20 &= 40 \\
4 \times 5 &= 20 \\
10 \times 5 &= 50 \\
\hline
&110
\end{aligned}
$$

The result (110) is cents per hundred pounds, or $1.10. This amount multiplied by 20 (the number of hundredweight per ton) gives the value of a ton of fertilizer of the proportions indicated.



Hauling out manure to save the land.

46. Is there a difference between the commercial value and the agricultural value of a fertilizer?

There is. The commercial value of a fertilizer is what it will bring in the market; while the agricultural value is determined by the increase of yield due to its use. Under some conditions the agricultural value may be greater than the market price; under other conditions it may be much less, depend-

ing upon the character and condition of the soil, upon the season, and upon the crop grown; also, and mainly, upon the knowledge, skill, and judgment of the farmer.

47. What is farm manure?

Decaying vegetable and animal matter, such as accumulates about stables, farmyards, and fields; especially the wastes of animals, including the litter used in bedding them.

48. What plant-food elements does farm manure contain?

As manure is decaying vegetable and animal matter, it contains all of the elements which contribute to plant growth.

49. To what losses is farm manure liable?

To the loss of nitrogen through heating, and the loss of nitrogen, potash, and phosphoric acid as a result of leaching or washing out.

50. How great may this loss be?

Under ordinary conditions of neglect, it may amount in six months to from one-half to three-fourths of the total value.

51. How may this loss be prevented?

By taking the manure direct from the barn and spreading it on the fields, or by storing it so as to prevent heating and leaching.

52. How may the heating of manure be prevented?

As heating results from too rapid decay, it may

be prevented by keeping the manure well packed and thoroughly wet, which excludes the air.

53. How may the leaching of manure be prevented?

By storing it under roof in a pit or cellar with cement or other water-tight floor and walls.

54. How should farm manure be applied to plow land?

On open sandy soil, it should be spread on the surface after plowing; on heavy clay soil it should be spread on the land and plowed under.

A heavy hay crop and a group of happy haymakers.

55. How should farm manure be applied to grass lands?

On meadows, it may be applied with a manure-spreader or otherwise from midsummer till the fol-

lowing spring; on pastures, from late fall till late winter, most heavily near the hilltops.

56. In addition to supplying plant food, how does farm manure improve the soil?

It increases its power to absorb and retain moisture; it acts as an indirect fertilizer, making available the potash, phosphoric acid, and other mineral plant foods; it encourages the growth of certain helpful bacteria; and it aids in regulating the temperature of the soil.

SOIL WATER

57. Why is water needed in the soil?

To dissolve the plant food; for plants can take up their food from the soil only when it is in solution in water.

58. How much water do plants require?

About sixty gallons of water for the production of a pound of dry matter; or, about 200,000 gallons of water to produce an acre of corn yielding fifty bushels. Some crops require more, some less.

59. How many kinds of water are found in the soil?

Three—free, capillary, and hygroscopic.

60. What is meant by free water?

The water that stands on or in the soil or passes freely through it; such water as may be removed by drainage.

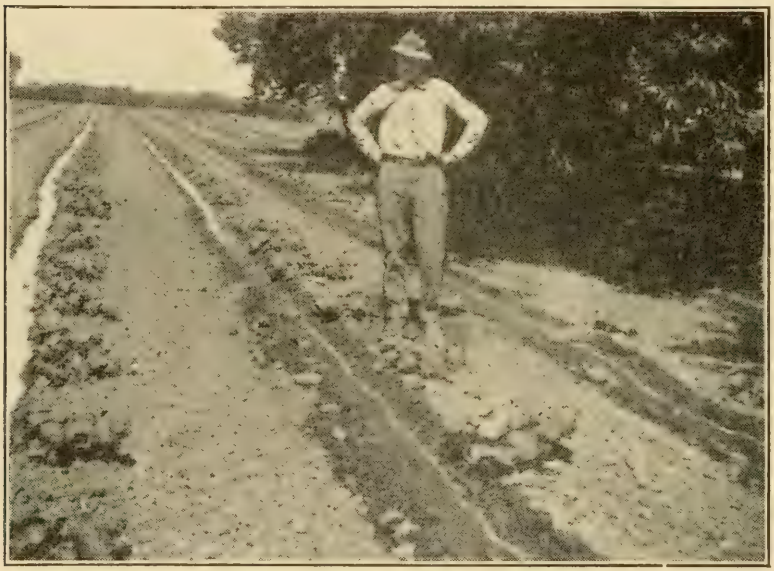
61. What is capillary water?

The water that cannot be drained out of the soil,

but which moves readily in any direction toward the driest places in obedience to what is called the law of capillary attraction; it is the water that supplies the plant roots with nourishment.

62. What is hygroscopic water?

The film of water held so firmly by particles of air-dry soil that the root-hairs cannot absorb it.



Irrigation water on the plants.

63. How may the water-holding capacity of the soil be increased?

By deep plowing and the addition of vegetable matter. The general character of the soil influences this capacity; but drainage and tillage are very important. Whatever gives the soil a sponge-like quality increases its water-holding capacity.

64. What is irrigation?

Irrigation is the application of water to cultivated land by some artificial means.

65. When and where is irrigation necessary?

In arid and semi-arid regions and in all sections of the country during drouth seasons.

66. What methods of irrigation are generally used?

During drouth seasons in the rainy sections various kinds of sprinklers are used by gardeners and others for watering their plants. In large sections of the United States west of the hundredth meridian, when the rainfall is insufficient, extensive irrigation plants have been put in by the government and private capitalists, damming up the rivers which are fed by melting snows on the mountain tops, and the water conveyed over the land through a system of ditches.

67. What is the character of the land in the dry sections?

Usually very fertile and productive when water is brought to it in sufficient quantity.

68. What is soil drainage?

When land is swampy or too wet for agricultural purposes, when ditched or drained by artificial means it is called drainage.

69. How many kinds of drainage are there?

Two—surface drainage, as it is called, by means of open ditches, and under drainage, when some underground system is used.

70. What kind of drainage is best?

For permanent results, some form of under drainage. All things considered, earthen tile, laid at least three feet deep on proper grades, is best and most economical.

TILLAGE

71. What is tillage?

The stirring and pulverizing of the soil for the purpose of increasing the growth of plants.

Getting ready to sow oats on corn land.

72. How many kinds of tillage are there?

Two—the tillage that stirs the whole surface of the soil, and the tillage among the growing plants, or inter-tillage. Deep tillage extends to a depth of 6 or more inches; shallow tillage to a depth of less than 4 inches.

73. What is the effect of tillage?

It increases the water-holding capacity of the soil, conserves the water-supply, lets in air, aids in making plant food available, increases the root-feeding area, warms the soil, destroys weeds, and in other ways facilitates plant growth.

74. How is tillage performed?

The plow, harrow, and roller are the standard tillage implements, and are used for turning, pulverizing, and compacting the soil. Many special implements are used for each of these operations.

75. How is inter-tillage performed?

By the use of a large variety of tillage implements. In corn for example, it was common, years ago, to use small turning-plows. Later, one and two-horse shovel-plows came into use. At present, two-horse cultivators are in common use. These have from two to five or six narrow shovels or teeth in each gang. Harrows and weeders are also used.

76. How deep should corn ground be stirred by the cultivator?

When the corn is small, the cultivator may be allowed to stir the soil to a considerable depth. After the roots have partially occupied the surface soil between the rows, the cultivator teeth should not be allowed to go deeper than two inches, or the roots will be severely injured. The same rule applies to other tilled crops.

77. In addition to destroying weeds, what are the important effects of cultivation?

It makes the soil more open to air and to water

that falls as rain and hinders the evaporation of soil-water by forming what is called a dust mulch.

78. When is deep plowing best?

Deep plowing is best when the soil is underlain by what is known as "hard-pan" or by a hard clay. When the soil is deepened, it should be done by plowing about an inch deeper each year.

79. What is subsoiling?

Under some conditions it is advantageous to break up and loosen the subsoil in the bottom of the furrow made by the common plow without throwing the subsoil to the surface. This operation is called subsoiling, and for it a special kind of plow is used called a subsoil plow, which is drawn by another team following the surface plow.

80. When is shallow plowing best?

Shallow plowing is best when the humus is limited and lies at or near the surface; also when the soil is sandy with a porous or sandy subsoil.

III. PLANT MANAGEMENT

PLANTS

81. What are plants?

Excluding the lower and parasitic forms, plants are living organisms having the power to appropriate their nourishment from water, from plant food dissolved in water, and from the carbon dioxide in the air; usually consist of three distinct parts—roots, stem, and leaves—and are without the power of moving from place to place.

82. What are roots?

The part of a plant which extends from the stem into the earth.

83. How do roots distribute themselves in the soil?

Equally in all directions if the soil is uniform in condition and fertility. When the soil lacks uniformity, the roots grow in the direction of the most abundant and most accessible plant food.

84. In what special ways do root systems distribute themselves?

Some plants have tap-roots which penetrate deep into the earth; others have no tap-roots, but only the spreading roots common to the higher plants.

85. What is the work or function of roots?

To attach the plant to the soil and to absorb soil-water containing dissolved plant food.

86. How is plant food absorbed by roots?

By the power known as osmosis.

87. What is osmosis?

The power or tendency which causes fluids to mix or diffuse through vegetable or animal membranes, the movement in liquids being usually most rapid from the more dilute to the denser liquid.

88. How does this result in feeding the plant?

The soil-water passing into the plant through the outer walls of the root-hairs carries dissolved plant food with it.

89. What becomes of the water absorbed by the roots?

It is forced or drawn up through the stem and branches of the plant to the leaves.

90. What becomes of the water sent up from the roots of the plant to the leaves?

Most of it is evaporated from the surface of the leaves, the remaining portion assisting in the distribution or diffusion of the elaborated plant food.

91. At what point does a root increase in length?

Just behind the tip or root-cap; the tip itself is hardened to enable it to move forward in response to the pressure from the growing cells behind it.

92. Where does the absorption of soil-water take place?

Through the root-hairs and the newer portions of the lengthening roots.

93. What is the function of the stem of a plant?

It connects the root-system with the leaf-system, in many cases maintaining itself and its branches in an upright position.

94. What is elaborated plant food?

The raw plant food that has been absorbed by the plant through its roots and its leaves and then so acted upon in the leaves that it is in condition to nourish the plant.

95. What are the functions of leaves?

They are the breathing and digesting organs of the plant.

96. How is plant food digested in the leaves?

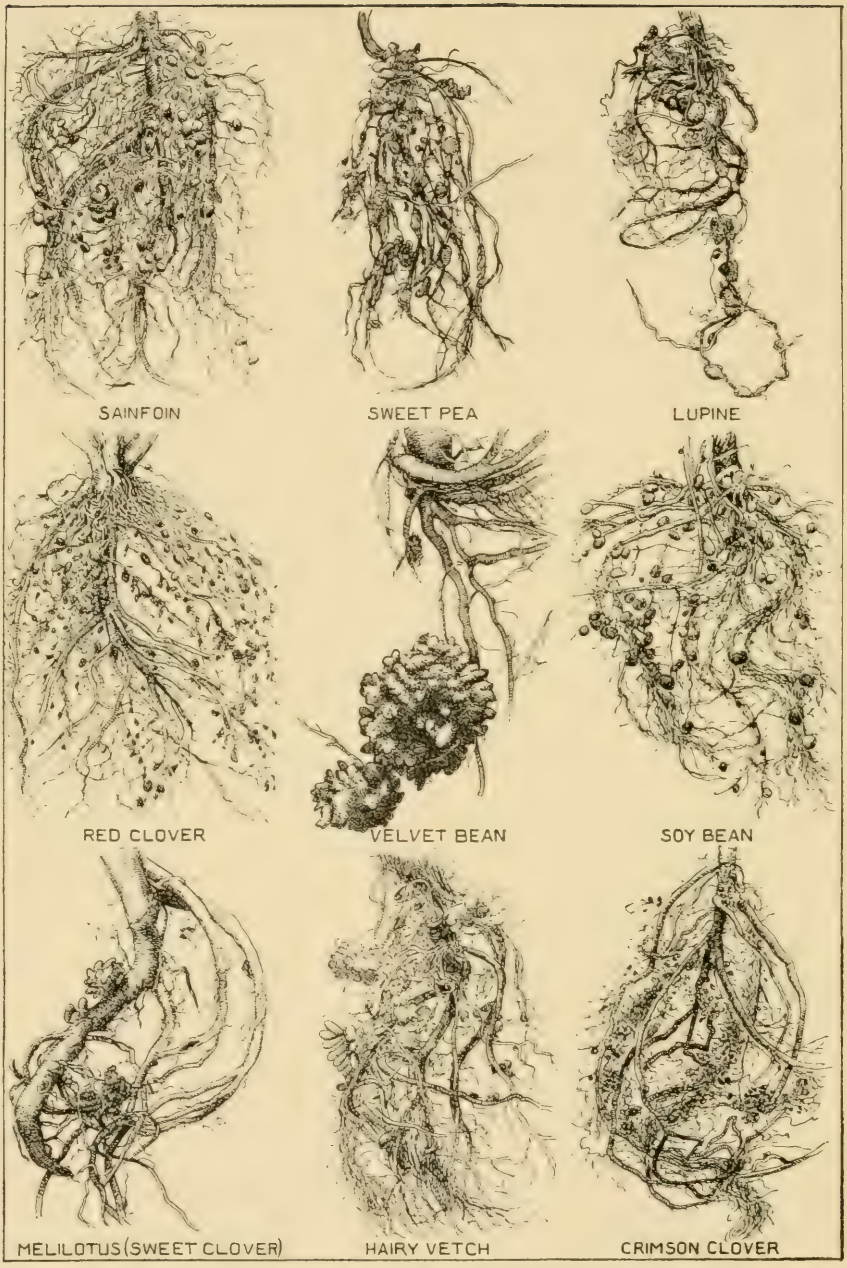
The protoplasm of the leaves, in the presence of sunlight and with the help of a green substance known as chlorophyl, transforms the food elements into starch and other organic compounds which are available for the building up of the plant structure.

97. What is protoplasm?

The active living substance of the cells of both plants and animals; in it and by it the life-processes are carried on.

98. How does the plant get its carbon?

In the breathing processes of plants, the leaves take in carbon dioxide with the air. This carbon dioxide is appropriated by the protoplasm and, in the presence of sunlight, and with the aid of chlorophyl, broken down and recombined to make other compounds, chiefly starch.



A collection of legumes showing the nodules on the roots.

99. How do plants get their oxygen and hydrogen?

From the water taken in through the roots. Water is a compound of two parts hydrogen and one part oxygen.

100. How do plants get their mineral matter?

From the soil. It is taken up by the roots when dissolved in water. All mineral matter is found in the ashes when the plant is burned.

101. How do plants get their nitrogen?

Most plants, including the cereal grains and grasses, get their nitrogen as dissolved nitrates taken up through the roots. The legume family of plants, which includes all the peas, beans, clovers, alfalfa and many others, have the power of using the free nitrogen of the air.

102. Why are legumes especially valuable as a farm crop?

Because they add nitrogen to the soil, which is the most expensive fertilizing element, and also furnish protein, the most expensive animal food compound.

103. Why are plants useful to man?

Because they are the direct and indirect source of supply of his food and clothing and of many other articles that serve his needs and his tastes; also because of the services which animals supported by plants are able to render.

104. What plants are most useful to man?

Those that have been domesticated or adapted by

selection, cultivation, and other means to the special purposes of man.

CULTIVATION

105. What is the environment of a plant?

All of the things and conditions that surround and influence a plant are called its environment—such as heat, moisture, light, food, and the physical and chemical condition of the soil; also other plants, diseases, insects, birds, and other animals.

106. In what ways is the environment of cultivated plants more favorable than that of plants in the wild state?

In the wild or natural state, plants compete with each other for room and other conditions favorable to growth; under domestication, man controls or modifies the environment, and the plant is given the most favorable conditions for its development in the direction desired.

107. How does man control the environment of plants?

By determining the kind and limiting the number that shall grow on a given area and by making the conditions favorable to growth by cultivating, fertilizing, draining, and watering the soil.

108. What is the first step in cultivation?

The preparation of the seed bed.

109. How is the seed bed usually prepared?

By plowing or otherwise breaking up the soil and

by the use of other implements to pulverize it more completely.

110. What is the second step?

Planting the seed.

111. What is the third step?

Tilling the soil among the plants—inter-tillage.

112. How does tillage benefit the plant?

By making plant food more available, promoting the increase of feeding rootlets, aerating the soil, conserving soil moisture, increasing wholesome bacterial activity, and destroying weeds.

113. What is plant propagation?

The artificial increase or multiplication of plants by taking advantage of their natural tendencies.

114. How are plants propagated?

By the use of seeds or spores and by the use of parts of the living plant, the latter being known as division and having many modifications.

115. What is the distinction between propagation and reproduction?

Propagation may be the mere continuation of the old individual, as in the case of a cutting or the runner of a strawberry plant; while reproduction implies the union of cells of opposite sexes and is effected by the use of seeds or spores.

116. What are the principal forms of propagation by division?

Propagation by suckers or sprouts that originate from roots or underground stems; by stolons or

Harvesting a crop of three tons of timothy hay an acre on a well-managed farm.

branches that start at or near the surface and root themselves at joints or tips after growing a considerable distance above the ground; by layers or parts of the plant surrounded or covered with earth to promote rooting; by division of the crown of the plant, as in case of the rhubarb; by bulbs, like those of the lily; by bulbels or bulblets, as onion sets; by corms, as those of the crocus; by tubers, as those of the potato; by leaves, slips, and cuttings of matured wood, which are rooted after being cut from the living plant; by budding and grafting, which involve the attaching of the living bud or scion to another tree or branch than that on which it grew, this being the common way of propagating peaches and apples.

117. What are the principal classes of crops grown by farmers?

Grain crops, such as corn, wheat, oats, and rice; forage crops, such as the clovers, grasses, and other plants from which hay and fodder are made; fruit crops, such as apples, peaches, plums, cherries, and grapes, the fruit-growing farmer being also known as a horticulturist; vegetable crops, including potatoes, beets, carrots, asparagus, cabbage, lettuce, and a long list of other plants, the vegetable farmer being also called a gardener or truck-farmer.

118. How are grain and forage plants propagated?

By seeds planted in the earth.

119. What precautions should be taken in selecting seed?

Such as will assure trueness to type and variety,

adaptability to soil and climate, purity, a high degree of germinating power, and productiveness.

120. How deep should seeds be planted?

Usually about two or three times the diameter of the seed—deeper when the soil is warm, dry, and porous; shallower when it is cold, wet, and heavy.

121. What does the seed need in order to germinate or sprout?

Water, air, and a certain degree of heat.

122. In addition to water, air, and heat, what does the growing plant need?

Dissolved plant food and sunlight.

PLANT ENEMIES

123. What are plant diseases?

Affections due to the attacks of fungi, bacteria, and nematode or eel worms, and to imperfect nutrition.

124. What are fungi?

Low forms of plants, which secure their nourishment from other plants, upon which they live as parasites, or from decaying organic matter.

125. What is organic matter?

Any substance which is the product of the growth of animal or plant. The organic matter of the soil consists of the remains of plants or animals or of both.

126. How do fungi (singular, "fungus") injure the plants upon which they feed?

By consuming their elaborated sap, destroying their tissues, disfiguring or killing their seeds and fruits, and in other ways making them less useful to man.

127. How are fungous diseases prevented or cured?

By the use of remedies called fungicides, which either destroy the spores of the fungi or prevent or retard the development of the fungous diseases, enabling the infested plant to mature its fruit.

128. What fungicide is most commonly used?

The bordeaux mixture.

129. How is it prepared?

To make a 50-gallon barrel of bordeaux mixture, dissolve three pounds of copper sulphate (blue vitriol) in two or three gallons of warm water by suspending it in a cloth sack in the upper part of a wooden or earthen vessel containing the water. While the sulphate is dissolving, slake five pounds of fresh lime and make it into a thin solution by adding two or three gallons of water. Put about 25 gallons of water into the spray barrel; add the sulphate solution, stirring thoroughly; after which pour in the milk of lime, continuing the stirring for some time. The milk of lime should be carefully strained before being put into the barrel, to avoid clogging the pump and spray nozzles. This is the strong bordeaux mixture, suitable for use on apple trees; for use on peach and plum trees, it may be made with two pounds of copper sulphate and five of lime.

A large and profitable field of wheat, showing the result of scientific cultivation.

130. What are some of the more common fungous diseases?

The smuts of corn and other grains, the black-knot of the plum and cherry, the black rot of the grape, potato blight, apple-leaf rust, apple-scab, and bean anthracnose.

131. How may these diseases be prevented?

Some of them (as the smuts) by treating the seed with chemicals or hot water, preferably by immersing the seed for ten minutes in water at a temperature of 135 degrees Fahrenheit; some of them (as the smut of corn and black-knot) by cutting out the affected part; and most of the others by the application of the fungicide known as bordeaux mixture.

132. What diseases of plants are caused by bacteria?

Pear blight, which attacks both pears and apples, is one of the most noteworthy of bacterial diseases. Brown rot of tomatoes and potatoes, boll rot of cotton and a number of other bacterial diseases are caused by bacteria closely related to the species which causes pear blight. None of them are well understood, and no satisfactory treatment has been discovered.

133. What are eel worms?

The eel worms or nematodes which cause diseases of plants are microscopic worms, and do serious injury to roses, tomatoes, cucumbers, and some other plants by causing the growth of galls.

134. How do insects injure plants?

By eating their leaves and fruit, boring into fruits and seeds, sucking the juice from bark and leaves, burrowing in stems and even in the trunks of large trees, and in many other ways.

135. How are insects classified as regards their eating habits?

They are divided into two groups—biting insects and sucking insects. Those of the first group eat by biting and chewing; those of the second, by puncturing the skin or bark of the animal or plant upon which they feed and sucking its blood or sap.

IV. FARM CROP MANAGEMENT

FARM CROPS CLASSIFIED

136. What are farm crops?

Sometimes called field crops, and includes all crops that are extensively cultivated and adapted to extensive rather than intensive cultivation.

137. What crops are so classified?

All the leading cereals such as corn, wheat, rye and oats, and all forage crops grown for hay or pasture, potatoes, tobacco, buckwheat and a number of others.

138. How are field crops classified?

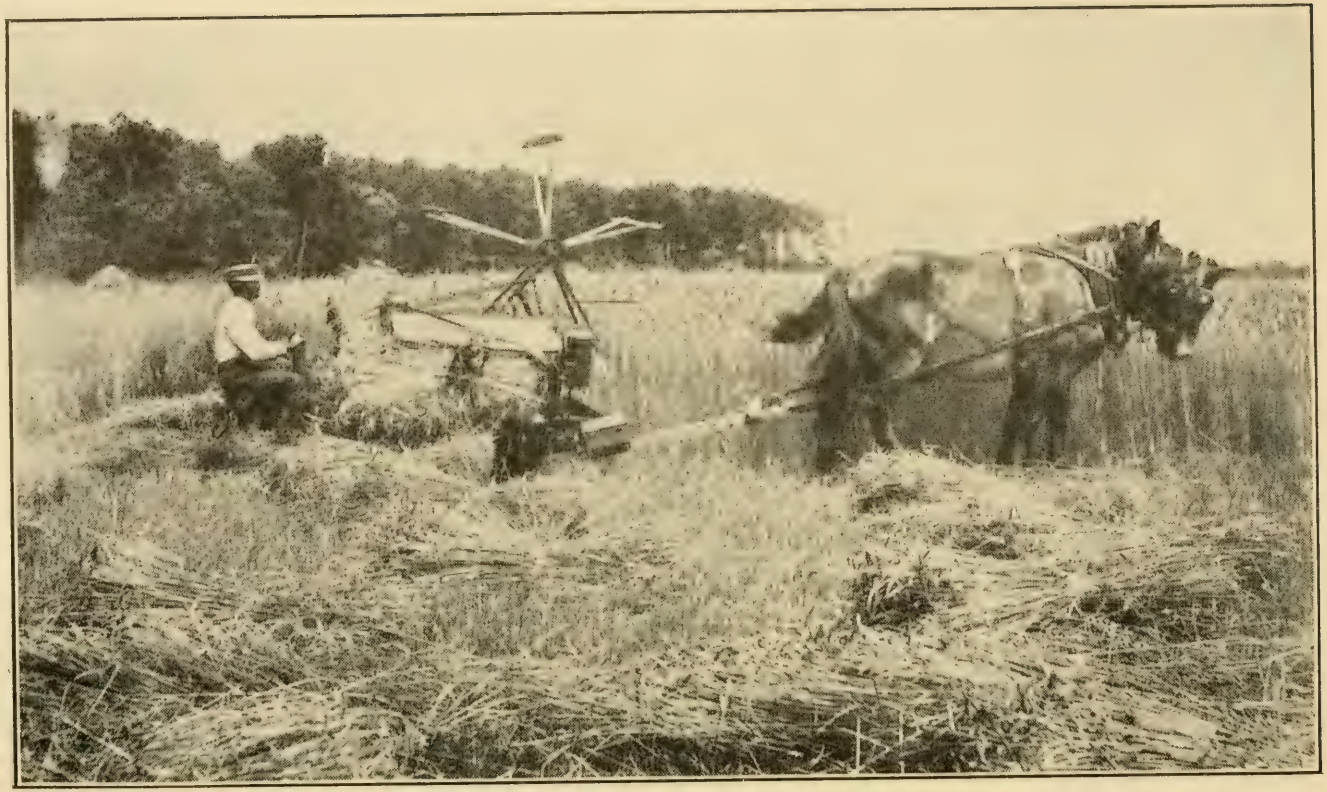
They may be classified as cereals, grasses, legumes, tubers, roots, sugar plants, fibers, with other minor classes.

139. What are cereals?

Any grass grown for its edible grain is called a cereal, which includes the whole plant. Buckwheat is not a cereal, but it is generally put in that class because its grain has a similar use.

140. How are cereals cultivated?

All cereals are annual grasses and are planted or sown in properly prepared seed beds. Corn is planted in rows one or both ways and intercultivated while growing with an implement adapted to that purpose. The small grains, as wheat or oats, are drilled or sown broadcast in a properly pre-



A modern harvester cutting a field of wheat that yielded 39¾ bushels an acre.

pared seed bed without subsequent cultivation.

141. Are other grasses largely cultivated?

Yes. A very large area is devoted to hay, pasture and forage crops in the United States.

142. How are these crops grown?

Some of them, as the millets, are annuals, though most of them are perennial, growing two or more years from the same seeding, such as timothy, orchard grass, blue grass and many others.

PASTURES AND MEADOWS

143. What are pastures?

Pastures are areas of land or fields where grasses and other forage plants are grown more or less permanently for grazing by farm stock.

144. To what conditions are pastures best adapted?

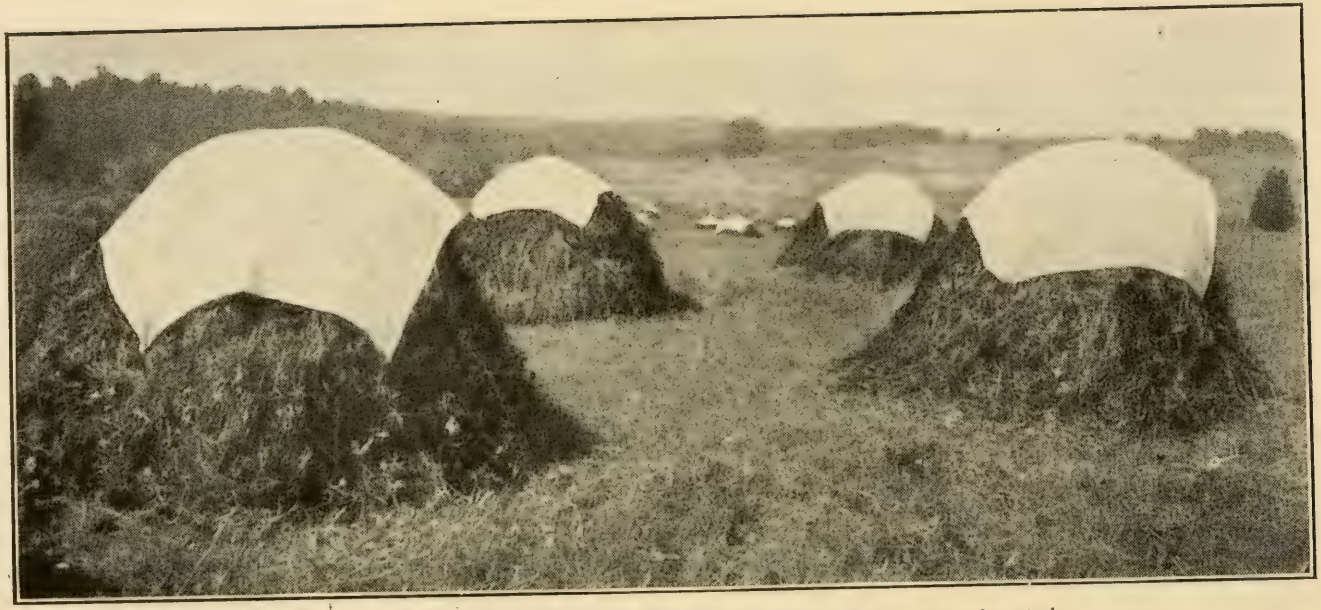
To rough, steep and stony lands, too rough for cultivation or so steep that they would wash or erode badly if plowed.

145. What are meadows?

Meadows are areas of land sown to grass which is allowed to grow to maturity when it is cut, dried and stored for animal feed.

146. What kind of land is best adapted to meadows?

Meadow grasses grow best in rich, moist lands, which should be comparatively level and smooth so that mowers and hay-handling machinery may be easily operated over them.



A bountiful crop of hay from an old field once supposed to be exhausted.

147. **Are plants other than grasses used for hay?**

In addition to all the grasses including the cereals, all the legumes are sometimes made into hay.

148. **What are legumes?**

The legumes include all the peas, beans, clovers, and many others classified by botanists as the leguminous or pea family, of which there are about 300 varieties. The best known in this country as hay or forage plants are clover, alfalfa, cowpeas, soybeans and Canada field peas.

149. **Are legumes grown for other purposes?**

Peas and beans are largely grown for human food, and should be used more generally than they are. Our people should "know beans" better than they do.

150. **What is a forage crop?**

In its broadest sense it means any kind of food for animals, and means about the same as "roughness," which includes the whole plant without the grain. Most of the plants used for forage are either grasses or legumes.

ROOTS AND TUBERS

151. **What is a tuber?**

A tuber plant is one that develops on its roots an enlarged stem. The best known and most important is the common white or Irish potato. The Jerusalem artichoke and chufa are also grown in a limited way.

Experiments showing timothy breeding for improvement.

152. What are root crops?

Root crops are plants grown for their roots which are used for stock or human food such as turnips, rutabagas, carrots, beets, parsnips and the like. They are not largely grown in the United States, but are in Canada and some European countries.

153. Why are root crops not generally grown in this country for stock food?

Partly because climatic conditions are unfavorable, but mainly because of the cheap and abundant production of Indian corn, which is king of stock foods.

154. What are principal sugar-producing crops?

The sugar produced in this country is almost wholly derived from sugar beets grown in the North and West, and sugar cane grown in Louisiana and some other southern states. Sorghum is also grown for the production of syrup. Some sugar and syrup is made from the hard or sugar maple.

FIBER AND STIMULANT CROPS

155. What are the principal fiber plants of the United States?

The only fiber crops grown in field cultivation are cotton, flax, and hemp. Of these, cotton is by far the most important.

156. What stimulant farm crops are raised?

Tobacco is of American origin and has been grown in large quantities since the first settlement

of the country. Tea is grown in a small way and coffee is profitably grown in Porto Rico and Hawaii.

LIMITING FACTORS

157. What are the limiting factors of crop production?

The limiting factor of first importance is climate

A well-developed hill of sweet potatoes grown in good soil.

which may be modified to some extent. The water supply may be increased or reduced by irrigation or drainage. Next to the climate the soil is the limiting factor which may be greatly modified by manuring and cultivation.

158. Are all soils equally adapted to all farm crops?

No. Certain soils may be better adapted to wheat and corn; to legumes and potatoes or to tobacco and wheat.

159. How may the adaptability of the soil be determined?

By physical and chemical analysis or by actual experience with a given crop on the land itself. The last is by far the most reliable.

CROPS TO GROW

160. Upon what does the profitableness of a crop depend?

Growers of farm crops have learned that the profit may depend upon many things, the character of the soil, rainfall, markets and transportation facilities. Under one set of conditions the production of certain crops might result in loss, while other crops might be profitable. Every crop grower should carefully consider these things.

161. What other factors should be considered in deciding what crops to grow?

Since farmers must spend most of their waking hours about their business, they should consult their own likes and dislikes and do the things that give them most pleasure. Their experience and capital available should also be considered.

162. What is the safest guide for determining the best crops to grow in any neighborhood?

As a rule the crops that have been generally

grown in that locality are safest. As a general proposition the people who have long lived and farmed in the same locality have adjusted themselves well to the environmental conditions. It is safer to attempt to improve the crops already grown than to introduce new ones. New crops in any locality should be grown experimentally at first.

163. What is meant by specialty farming?

Specialty farming is growing a single crop. A

Yard and sheds for cattle feeding.

good illustration is the great wheat farms of the Northwest. Commercial orcharding is rapidly becoming specialized.

164. What is general farming?

As distinct from specialized farming, a man who grows several kinds of crops, including live stock, is called a general farmer. There are many advantages in general farming, the most important of

which are opportunity for rotation of crops, distribution of labor and the practical certainty that all crops will not fail at once.

165. What effect has one-crop farming upon the land?

Professor Carrier of Virginia says one-crop farming has ruined more farms in America than any other cause. Continuous cropping, year after year, with tobacco in Virginia, North Carolina, and Kentucky; with corn in Indiana, Illinois and Iowa; with wheat in Minnesota and the Dakotas; and with cotton in the Gulf States has in each instance had the same effect—and that is soil depletion.

166. How may soil depletion be avoided?

By growing a variety of crops, judicious rotation, growing soil-improving plants, keeping live stock, saving the manure and in every possible way returning to the soil the fertility removed by the crops.

ROTATION

167. What are the advantages of rotation?

The advantages of rotation may be summarized as follows—distributes the labor throughout the year; different plants require different food elements; some plants go deeper in the soil than others; keeps down weeds; legumes take nitrogen from the air; prevents leaching by keeping the ground covered; furnishes income throughout the year; gives variety of forage and reduces insect pests.

168. What is a good five-year rotation?

First year, corn; second year, wheat or oats;

third year, wheat, sown to timothy and clover; fourth year, hay; fifth year, hay or pasture.

169. What is a good four-year rotation?

First year, corn, potatoes or tobacco; second year, wheat, sown to timothy and clover; third year, hay; fourth year, hay or pasture.

170. What is a good three-year rotation?

First year, corn, or cotton in the South; second year, cowpeas, soy beans, or Canada field peas; third year, wheat followed by cowpeas or rye for a cover crop to be plowed under the next spring.

171. What are some other methods of rotation?

Catch crops may be grown to advantage in some localities. Cowpeas, crimson clover or rye may be sown in the corn at the last cultivation. In every rotation at least one legume crop should be grown.

V. ANIMAL MANAGEMENT

PRINCIPLES OF BREEDING

172. What are domestic animals?

Such animals as have been tamed or domesticated by man and made of value to him.

173. Which are most valuable?

Horses, cattle, sheep, swine and poultry.

174. What is the best animal to keep?

Whether kept for flesh, milk, eggs, wool or work, the best animal to keep is the one that will return the greatest quantity of the desired product for a given amount of feed.

175. What is the object of breeding?

The object of breeding is the improvement of domestic animals in those qualities which are of the greatest value to man.

176. What is a breed of live stock?

A distinct race or kind having characteristics or qualities that are quite uniformly transmitted from parent to offspring.

177. What is a pure breed?

A pure breed of animals is a race with well-established characters, bred for many generations without admixture of other blood.

178. **What is meant by cross-breeding?**

Cross-breeding is the mating of animals of different pure breeds; as Herefords and Shorthorns among cattle.

179. **What is a grade?**

A grade is a cross between a pure-bred animal and one of mixed or common breeding; as, the offspring resulting from the mating of a pure-bred Shorthorn with an animal of common or mixed blood. An animal of three-quarters or more of pure blood is called a high grade of that breed.

180. **What kinds of animals should be used for breeding purposes?**

Nothing but pure-bred males should be used; but for ordinary or butcher purposes well-selected grade or common females may be used.

181. **How are breeds of live stock established?**

By the application of well-established principles of reproduction and the selection of animals having the desired traits, which become fixed by inheritance.

182. **What are the fundamental laws or principles that govern breeding?**

While there are many principles that must be taken into account by the breeder, the three that are considered fundamental are: The law that like produces like; the principle of variation; and the principle of atavism.

183. **What is the law that "like produces like"?**

The law that like produces like means that the

offspring will bear a close resemblance to their parents; sometimes called the law of heredity.

184. What is the principle of variation?

The principle of variation is the well-known tendency of animals to develop characteristics different from their parents; also called the law that like does not produce like.

A handsome Holstein-Friesian cow showing fine dairy type.

185. What is the principle of atavism?

By the principle of atavism is meant the tendency of animals to revert to a more or less remote ancestral type. Among stockmen it is frequently called reversion, "throwing back," or breeding back.

A modern barn showing silos and herd of Holstein-Friesian cows.

186. What is meant by heredity?

By heredity is meant all of the characteristics, qualities, and tendencies transmitted by parents and more remote ancestors.

187. What do we understand by "type" as applied to animals?

When the special character of a breed has become fixed by inheritance, it is called a type; as, dairy and beef types among cattle, draft and speed types among horses, and mutton and wool types among sheep.

CATTLE

188. Which are the most important breeds of dairy cattle?

The Jersey, Guernsey, Ayrshire, Holstein, and Brown Swiss.

189. Which are the best known breeds of beef cattle?

The Shorthorn, Hereford, Polled Angus, and Galloway.

190. Which are known as dual-purpose breeds?

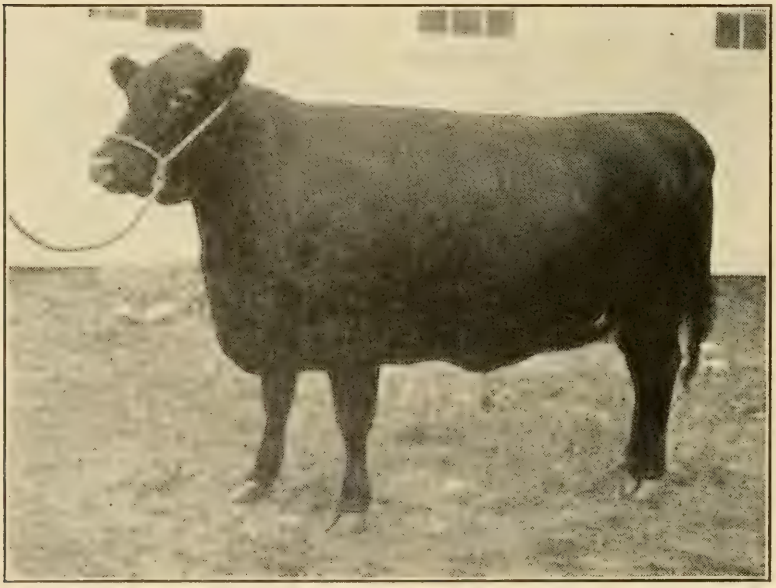
The Polled Durham, Brown Swiss, Red Polled, Devon, and some families of Shorthorn.

191. What are the characteristics of a dairy cow?

An angular, wedge-shaped body, small head, large mouth, well-developed udder, large stomach, good digestion, and the power to convert a large portion of feed into milk rich in butter-fat.

192. **What are the leading characteristics of a beef animal?**

The body well rounded, smooth, and compact; the upper and lower lines of the body nearly parallel; broad back and well-developed hindquarters; short, stout legs; a general appearance of blockiness; with large capacity for converting its feed into flesh, which is laid on where the best cuts of beef are found.



Good beef-type, Aberdeen-Angus.

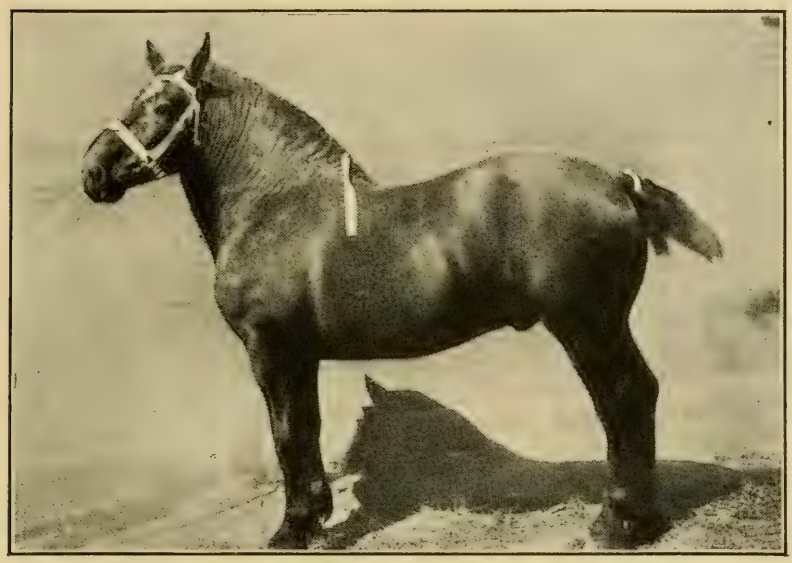
193. **What are the characteristics of dual-purpose cattle?**

Dual-purpose cattle are those which are capable in a fair degree of producing both meat and milk, and should be kept by farmers who seek returns in meat and dairy products.

HORSES

194. How are breeds of horses classified?

As draft, coach, and speed horses. In each class there are several distinct breeds, such as the Arabian, the Thoroughbred, or running horse, and the American trotting horse in the speed class.



Champion Percheron Stallion.

195. What are the chief characteristics of a draft horse?

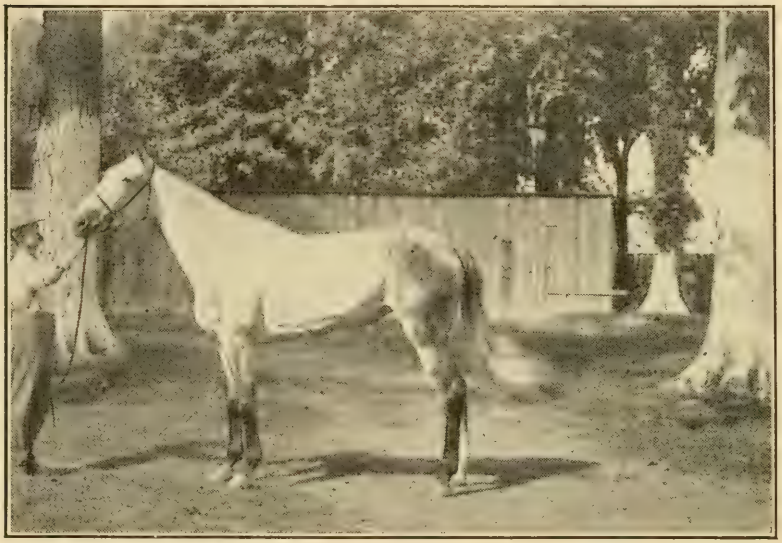
Great size, weight, and strength; broad back and large legs and feet; slow and deliberate motion, mild and docile disposition.

196. Which are the best known draft breeds?

The Percheron of France, the Shire of England, and the Clydesdale of Scotland.

197. What are the distinctive characteristics of the coach horse?

It is between the speed and draft horses in size, combining certain characteristics of both. In some respects it may be classed as a general-purpose horse.



Good type of roadster or driving horse.

198. Which are the leading breeds of coach horses?

The Cleveland Bay, an English breed; and the French and German coach horses.

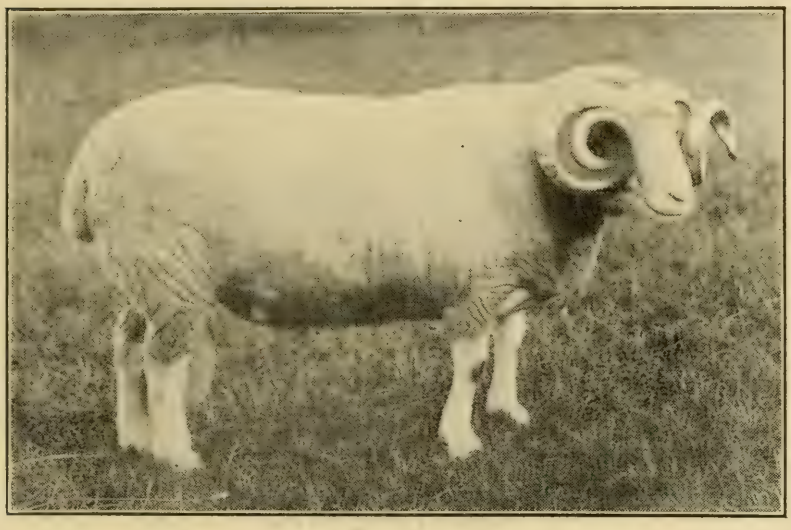
199. What are the chief characteristics of speed horses?

The chief characteristics of the speed horses are beauty, intelligence, courage, speed, and endurance. Speed horses have been purely bred longer than any other domestic animals. Pedigrees, or records of

pure breeding, were kept for horses for a long period before such records were kept for other animals. It seems that the speed horse has almost reached the highest possible improvement.

200. Which are the best known of the speed horses?

The Thoroughbred, or English running horse; and the American Trotter, Pacer, and Saddler. All of these are more or less directly descended from the Arabian horses.



Prize-winning Dorset ram.

SHEEP

201. For what purposes are sheep kept by farmers?

For the wool and mutton which they produce.

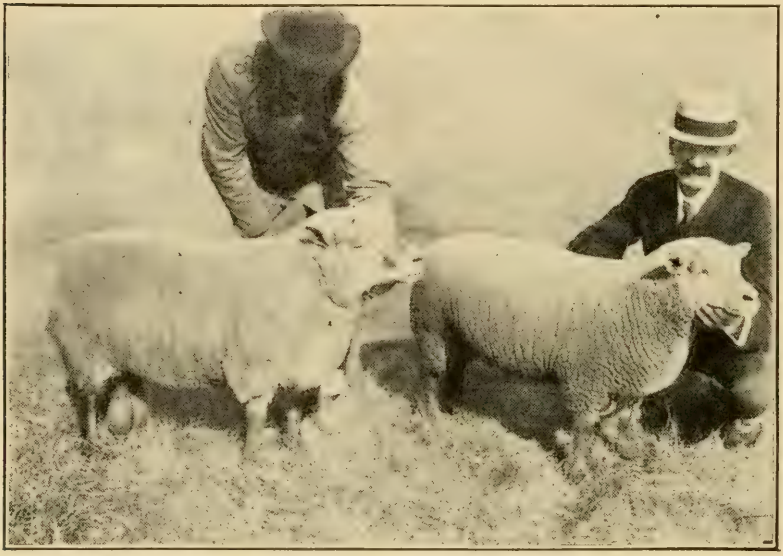
202. How are breeds of sheep classified?

Often according to the kind of wool produced;

as, fine-wool, middle-wool, and long-wool; sometimes as wool-producing and mutton breeds.

203. Which are the best known breeds of each class?

Fine-wool: Merino, Delaine, and Rambouillet; middle-wool: Southdown, Shropshire, Dorset,



Pair of prize-winning Shropshire sheep.

Hampshire, and Oxford; long-wool: Leicester, Cotswold, and Lincoln.

204. Which are the best known mutton breeds?

Southdown, Shropshire, Hampshire, Oxford, Dorset, Cotswold and Lincoln.

205. Where should sheep be kept?

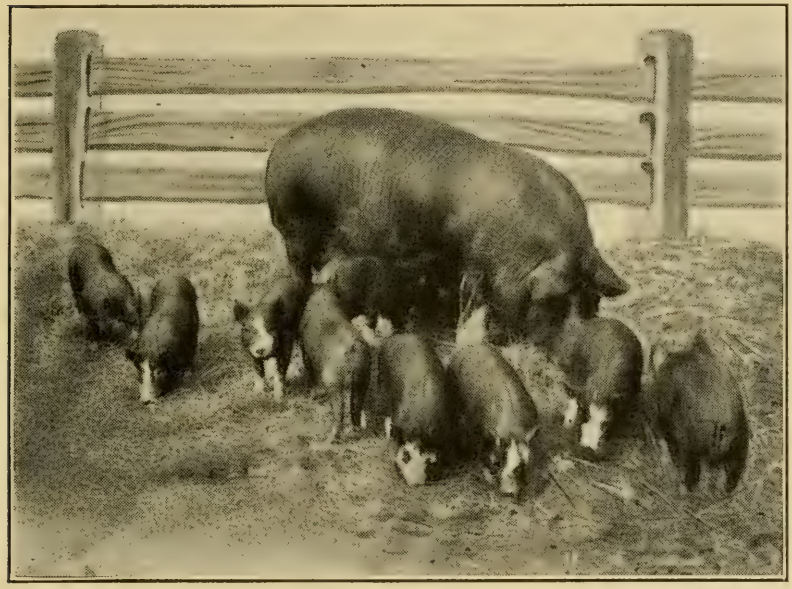
In rough, mountainous pastures, where the grass is scant and the surface steep. Sheep are natural

mountain climbers, but do not thrive on low or marshy lands.

SWINE

206. How are the breeds of swine classified?

According to size; as, large, medium, and small; also as lard and bacon hogs.



Fine specimen of Berkshire sow and nine pigs. Money makers for their owner.

207. Which are the leading breeds of each class of swine?

Large breeds: Chester White; Improved Yorkshire, and Tamworth; medium breeds: Berkshire, Poland-China, and Duroc-Jersey; small breeds: Suffolk, Essex, and Small Yorkshire.

208. What are the characteristics of bacon hogs?

They have the ability to produce a large amount of side meat of superior quality for the manufacture of bacon.

209. Which are the most typical bacon breeds?

The typical bacon breeds are the Large Improved Yorkshire and the Tamworth.

210. Which are the typical lard-producing breeds?

The Poland-China, Suffolk, Essex, and Small Yorkshire.

211. What are the essentials of form common to all breeds of swine?

Good length and depth of body, which should be in the shape of a parallelogram, with good width and compactness.

212. What are some of the advantages of keeping swine?

They can adapt themselves to many conditions; can utilize many waste products about a farm; require but little attention; and will produce a pound of flesh more cheaply than any other domestic animal. They are especially adapted to the corn-growing sections of the country.

POULTRY

213. Which are the best known kinds of poultry?

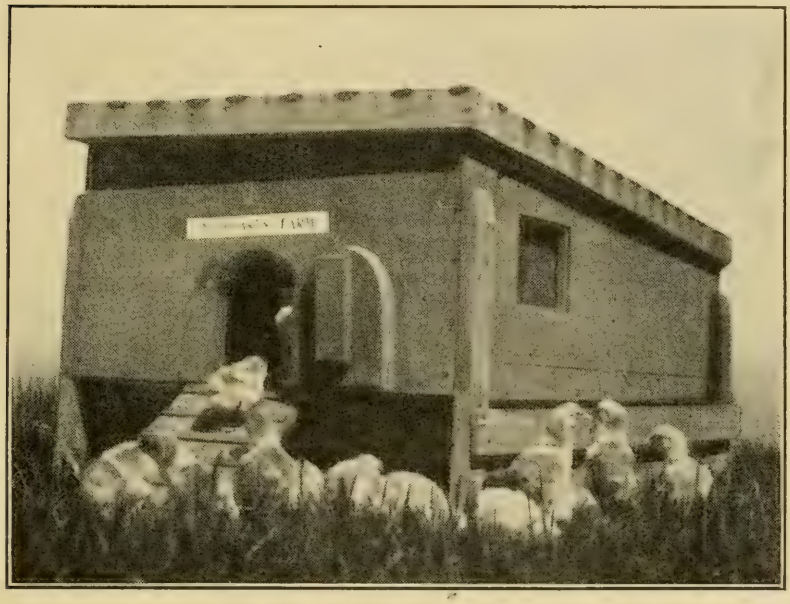
Chickens, turkeys, ducks, and geese. There are many breeds of each kind.

214. How are breeds of chickens classified?

As egg, meat, and general-purpose breeds.

215. Which are the best known breeds of chickens?

Of egg breeds the Leghorn, Minorca, and Houdan; of meat breeds, the Brahma, Cochin, and Indian Game; of general-purpose breeds, the Plymouth Rock, Wyandotte, and Rhode Island Red.



Small house for young chicks.

216. What kind of chickens should be kept?

Only pure-bred fowls; but care should be taken to select birds with good egg-producing records. The selection of a breed will depend mainly upon whether egg or meat production is the object.

217. Which are the best known breeds of ducks?

The Pekin, Rouen, Cayuga, Aylesbury, and several varieties of wild ducks.

218. Which are the most popular breeds of geese?

The African, Embden, Toulouse, Chinese, and Canadian.

219. What are the leading characteristics of ducks and geese?

All have webbed feet, are good swimmers, and spend much time in the water, being classed as

View of an extensive modern poultry plant.

waterfowls. They are kept for the production of meat, eggs and feathers; are hardy, easily raised, less liable to disease than chickens, and may be kept with large profit where conditions are favorable.

220. Where did the turkey originate?

In America, where wild turkeys are still found. The turkey is the one valuable domestic animal of American origin.

221. What are the habits of turkeys?

They are of a roving disposition and still retain

many of their wild habits; do not stand confinement well and are inclined to roost out of doors; are likely to wander off during the day and make their nests in remote and secluded places.

222. Why are turkeys kept?

For their flesh, which is more desired and brings higher prices than that of any other kind of poultry. They are especially popular for Thanksgiving and Christmas feasts.

FEEDING

223. Why do we feed animals?

Because animal bodies are built up or grow from the food consumed and digested.

224. Of what are animals' bodies composed?

Water, protein, carbohydrates, fat, and ash. From 40 to 60 per cent of the animal body is composed of water, which is supplied by the food and drink of the animal.

225. What are the important elements of animal feeds?

Those that produce muscle, blood, and hair or wool, called proteins; those that produce animal heat and energy, called carbohydrates and fat; and those that remain after an animal body is burned, called ash.

226. What is protein?

That part of the feed which contains nitrogen; in grain it is called gluten; in cheese, casein; and in eggs, albumen.

227. What are carbohydrates?

The starch and sugar compounds in animal feeds; they are the cheapest and most abundant nutrients in feeding stuffs. Some feeds are rich in protein; others in carbohydrates.

228. What is fat?

The oily substance of feeding stuffs. As fat is a heat and energy-producing material, the same as

Corn and sorghum grown for silage produced 15 tons an acre on red clay land formerly in a run-down condition.

carbohydrates, it is included with the latter after its carbohydrate value has been obtained by multiplying the amount of digestible fat by 2.25.

229. What is a feeding standard?

A feeding standard is the result of an effort to determine the amount of dry matter, and also the amount of digestible protein and of digestible car-

bohydrates, required daily by an animal weighing one thousand pounds.

230. What is meant by the term nutritive ratio?

By "nutritive ratio" is meant the proportion of digestible protein to digestible carbohydrate contained in the feeding stuff. For example, Indian corn contains 7.8 per cent of digestible protein, 66.7 per cent of carbohydrates, and 4.8 per cent of fat. The carbohydrate value of the fat is found by multiplying by 2.25; thus: 4.3 times 2.25 equals 9.7. Adding this amount to the percentage of carbohydrates, 66.7, gives 76.4; which amount divided by the percentage of protein (7.8) gives the nutritive ratio as shown in the table under question 197, or 1 : 9.8.

231. Do all animals of the same weight require the same kind and amount of feed?

They require very nearly the same amount to maintain a given weight when at rest; but need larger amounts and different proportions according to the work performed, such as labor and the production of flesh, bone, fat, milk, wool, feathers, and hair.

232. What is a feeding standard for an animal weighing 1,000 pounds?

For an ox at rest, 18 pounds of dry matter, containing .7 pounds of digestible protein and 8.15 pounds of digestible carbohydrates, the nutritive ratio being 1 : 12; for a horse at work, 22.5 pounds of dry matter, containing 1.8 pounds of digestible protein and 11.8 pounds of digestible carbohydrates,

the nutritive ratio being 1 : 7; for a milk cow in full flow, 25 pounds of dry matter, containing 2.5 pounds of protein, and 15 pounds of carbohydrates, the nutritive ratio being 1 : 6; for growing pigs, 42 pounds of dry matter, containing 7.5 pounds of protein and 30 pounds of carbohydrates, the nutritive ratio being 1 : 4.

233. Are there differences in the standards for large and small animals?

The standards are worked out on a basis of 1,000 pounds, which may be the weight of a single cow or horse, or of many pigs or chickens. In general, a little more feed in proportion to weight is required for small than for large animals because of the greater surface of their bodies in proportion to bulk.

234. Are these feeding standards reliable?

They are by no means absolutely accurate; but in their application chemists and physiologists have made great efforts to make them accurate, and they have been and are of great value to stockmen. Prudent feeders will never ignore them.

235. What is a balanced ration?

A balanced ration is one in which the bulk and the digestible protein and carbohydrates are in that proportion which will most economically produce the particular results desired in feeding.

236. How may a farmer know how much dry matter and digestible protein and carbohydrates his feeding materials contain?

By consulting what are known as nutrition tables. These have been published by the United States

Department of Agriculture and by various state experiment stations from the results of chemical analyses of all the common feeding stuffs, and show the amount of dry matter and of digestible protein and carbohydrates in the various feeds; as, clover hay, timothy hay, corn, oats, bran, cottonseed meal, and other stock feeds.

237. What amounts and proportions of digestible nutrients (protein, carbohydrates and fats) are found in some of the common feeding stuffs?

In the following table are shown the number of pounds of dry matter (D. M.), protein (P.), carbohydrates (C. H.), and fats (F.) in 100 pounds of four kinds of roughage and four kinds of concentrates together with the nutritive ratio (N. R.) of each of the feeding stuffs:

FEEDING STUFFS.	D. M.	P.	C. H.	F.	N. R.
Corn stover	59.5	1.7	32.4	.7	1: 20
Clover hay	84.7	6.8	35.8	1.7	1: 5.8
Timothy hay	86.8	2.8	43.4	1.4	1: 16.7
Oat straw	90.8	1.2	38.6	.8	1: 33.7
Corn	89.4	7.8	66.7	4.3	1: 9.8
Oats	89.0	9.2	47.3	4.2	1: 6.2
Wheat bran	88.1	12.2	39.2	2.7	1: 3.7
Linseed meal	90.8	29.3	32.7	7.0	1: 1.7

238. How may a ration for a dairy cow weighing 1,000 pounds be made up from the foodstuffs named in the foregoing table or any of the standard nutrition tables?

By making estimates and trial calculations until the right quantity of dry matter and the proper

amount and proportions of nutrients are obtained. In the ration below the amount of dry matter is greater than is usually allowed by the standards:

FEEDING STUFFS.	lbs.	D. M. lbs.	P. lbs.	C. H. lbs.	F. lbs.
Clover hay	8	6.776	.544	2.864	.136
Corn stover	10	5.95	.17	3.24	.07
Oat straw	3	2.724	.036	1.158	.024
Corn meal	5	4.47	.39	3.235	.215
Wheat bran	4	4.405	.61	1.96	.135
Linseed meal	3	2.724	.879	.981	.21
Total	33	27.049	2.629	13.438	.79

The nutritive ratio of the above ration is found by adding to the total carbohydrates 2 1-4 times the total fats and dividing by the weight of protein, thus: 13.438 plus (.79 x 2.25) —:— 2.629 equals 5.8, giving a nutritive ratio of 1 : 5.8.

ANIMAL JUDGING

239. What is animal judging?

It is the weighing and estimating of the characteristics and points of excellence of domestic animals with reference to their adaptation to the special use that is to be made of them.

240. Why should all stock raisers be good judges?

So as to know the value of the animals kept; to prevent being imposed upon in buying or selling and so as to be able to determine if they are keeping the best class of animals for their purposes.

241. How does being a good judge help a stockman?

Being a good judge of live stock through systematic study broadens his influence and usefulness in his community and brings him in contact with progressive breeders and men of affairs.

242. How does being a good judge benefit a stock feeder?

He understands market demands and knows how to select animals for feeding that will make profitable gains in the feed lot, and when finished will command the best prices in the market.

243. Why should a stock breeder be a good judge?

It enables him to select the best animals for his purposes or to detect any weakness or undesirable characteristics and to reject inferior animals.

244. What is the first requisite of a good judge?

A thorough knowledge of the history, characteristics and types of different breeds of domestic animals, including the breed standards, which have been adopted by the national associations for the registration of pure-bred live stock.

245. How many kinds of judging are there?

Two. Score-card judging and comparison judging.

246. What is a score card?

It is a detailed description of the parts of an ideally perfect animal, indicating the relative value of each part as indicated by the following dairy cow score card:

SCALE OF POINTS	Standard	Points deficient
HEAD—8 per cent.		
1. **Muzzle,** broad	1	
2. **Jaw,** strong, firmly joined	1	
3. **Face,** medium length, clean	1	
4. **Forehead,** broad between eyes, dishing	1	
5. **Eyes,** large, full, mild, bright	2	
6. **Ears,** medium size, fine texture, secretions oily and abundant, yellow color	2	
FOREQUARTERS—10 per cent.		
7. **Throat,** clean	1	
8. **Neck,** long, spare, smoothly joined to shoulders, free from dewlap	2	
9. **Withers,** narrow, sharp	3	
10 **Shoulders,** sloping, smooth; brisket light	3	
11. **Fore legs,** straight, clean, well set under body	1	
BODY—25 per cent.		
12. **Crops,** free from fleshiness	1	
13. **Chest,** deep, roomy; floor broad	6	
14. **Back,** straight, strong; vertebra open	3	
15. **Ribs,** long, deep, sprung, wide apart.	3	
16. **Barrel,** deep, long, capacious	10	
17. **Loin,** broad, strong	2	
HINDQUARTERS—12 per cent.		
18. **Hips,** prominent, wide apart	1	
19. **Rump,** long, level, not sloping	4	
20. **Pin Bones,** wide apart	1	
21. **Tail,** neatly set on, long, tapering	1	
22. **Thighs,** spare, not fleshy	3	
23. **Hind legs,** well apart, giving ample room for udder	2	
MAMMARY DEVELOPMENT—30 per cent.		
24. **Udder,** large very flexible, attached high behind, carrying well forward; quarters even, not cut up..	15	
25. **Teats,** wide apart, uniformly placed, convenient size	5	
26. **Milk veins,** large, tortuous, extending well forward	4	
27. **Milk wells,** large	6	
GENERAL APPEARANCE—15 per cent.		
28. **Disposition,** quiet, gentle	2	
29. **Health,** thrifty, vigorous	3	
30. **Quality,** free from coarseness throughout; skin soft, pliable; secretions abundant; hair fine	4	
31. **Temperament,** inherent tendency to dairy performance	6	
Total	100	

247. How are score cards made up?

All score cards for different breeds and varieties of live stock are made up in the same way and similar to the one given above. The value given to each point is, of course, arbitrary, but based upon the agreement of the best judges of the class of animals scored.

248. What are the advantages of a score card?

It helps the inexperienced judge to learn the names and location of the different parts of an animal, and prevents his overlooking any important points or characteristics.

249. What is comparison judging?

It is comparing the points of a great many animals with the ideal and with each other. It is the comparison of the parts of one animal with the parts of another of the same kind, class and age, keeping in mind the standard of that particular class.

250. What use is made of comparison judging?

Expert judges at fairs and stock shows usually judge by the comparative method. After a careful and thorough examination of all the competing animals by comparing one with another he decides which is best. In comparative judging much importance is given to uniformity of development.

251. What consideration should judges give to performance?

In judging horses, considerable value should be given to training, gait and all other factors involved in performance, for his ability to do the work ex-

pected is of primary importance. In judging a dairy cow, performance is of even more importance, and should be duly considered by the judge, because in the last analysis it is her ability to profitably produce milk and butter that fixes her value.

252. Who should be judges of live stock?

Every farmer, breeder, handler and dealer in live stock will find it decidedly to his advantage to become an expert judge of all species of animals and especially the class or classes of animals he handles, including poultry.

VI. DAIRY MANAGEMENT

MILK

253. What is the composition of milk?

Milk is about eighty-eight per cent water, in which are found about twelve per cent of solids, composed of fat, casein, albumen, sugar, and mineral matters.

254. How is the fat or cream separated from the milk?

Either by letting the milk stand in pans or other vessels, in which case the cream is separated from the heavier milk by gravity; or by the use of a cream separator.

255. How much milk does a cow produce in a year?

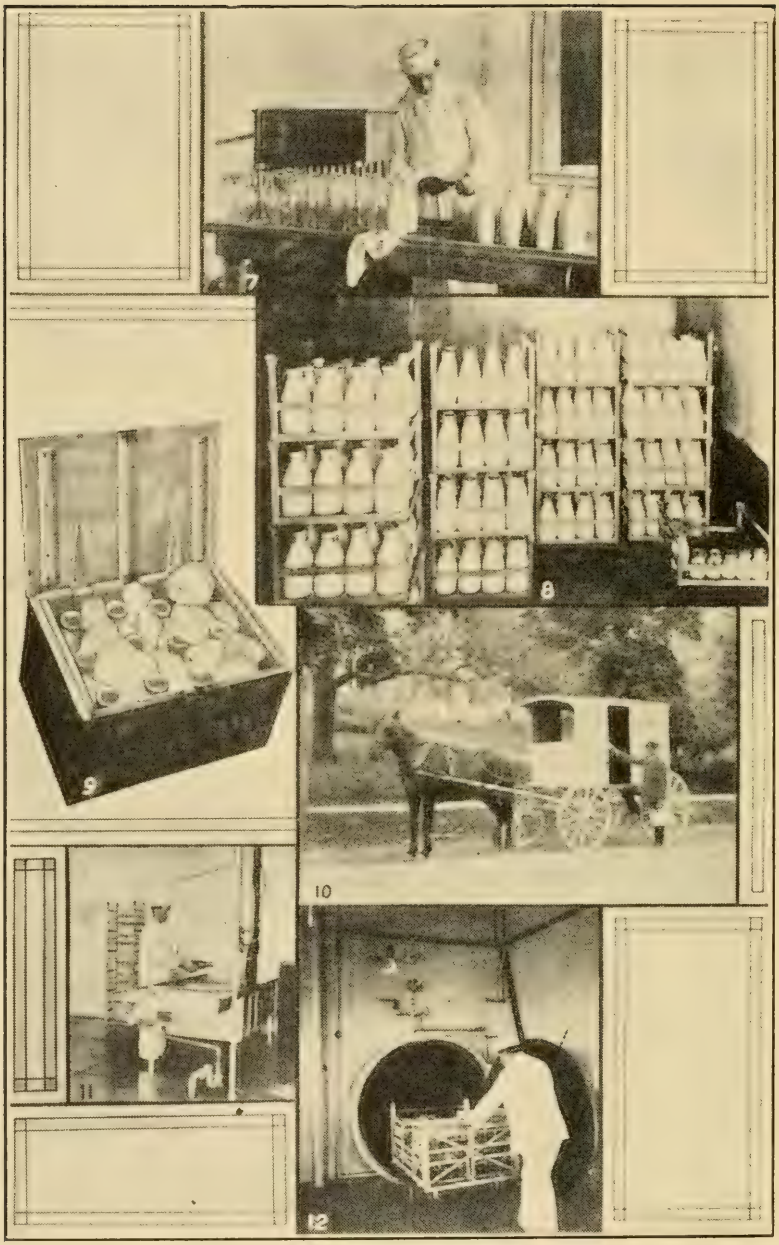
The average cow from four to five thousand pounds; in exceptional cases as much as thirty thousand pounds has been produced. The annual production by a cow of from six to ten times her own weight of milk is not unusual.

256. How much butter fat does milk contain?

The butter fat contained in cows' milk varies from less than three to more than six per cent, depending to some extent upon the breed, but largely on the individual animal.

257. What is the Babcock milk tester?

A machine invented by Prof. S. M. Babcock by which the exact amount of butter fat contained in



Part of the equipment of a modern dairy farm, showing delivery wagon and bottling operations.

milk may be easily and cheaply determined and the value of the milk ascertained.

258. What is necessary to the production of good milk?

Healthy cows and perfect cleanliness in handling and caring for the milk, in order to keep disease germs and other undesirable bacteria out of it.

259. What is pasteurized milk?

Milk that has been heated to a temperature of about 160 degrees and kept at that temperature for fifteen minutes and then rapidly cooled to 50 degrees. This destroys most of the germs and improves the keeping quality of the milk.

CREAMERY PROBLEMS

260. What questions are asked by creamery patrons?

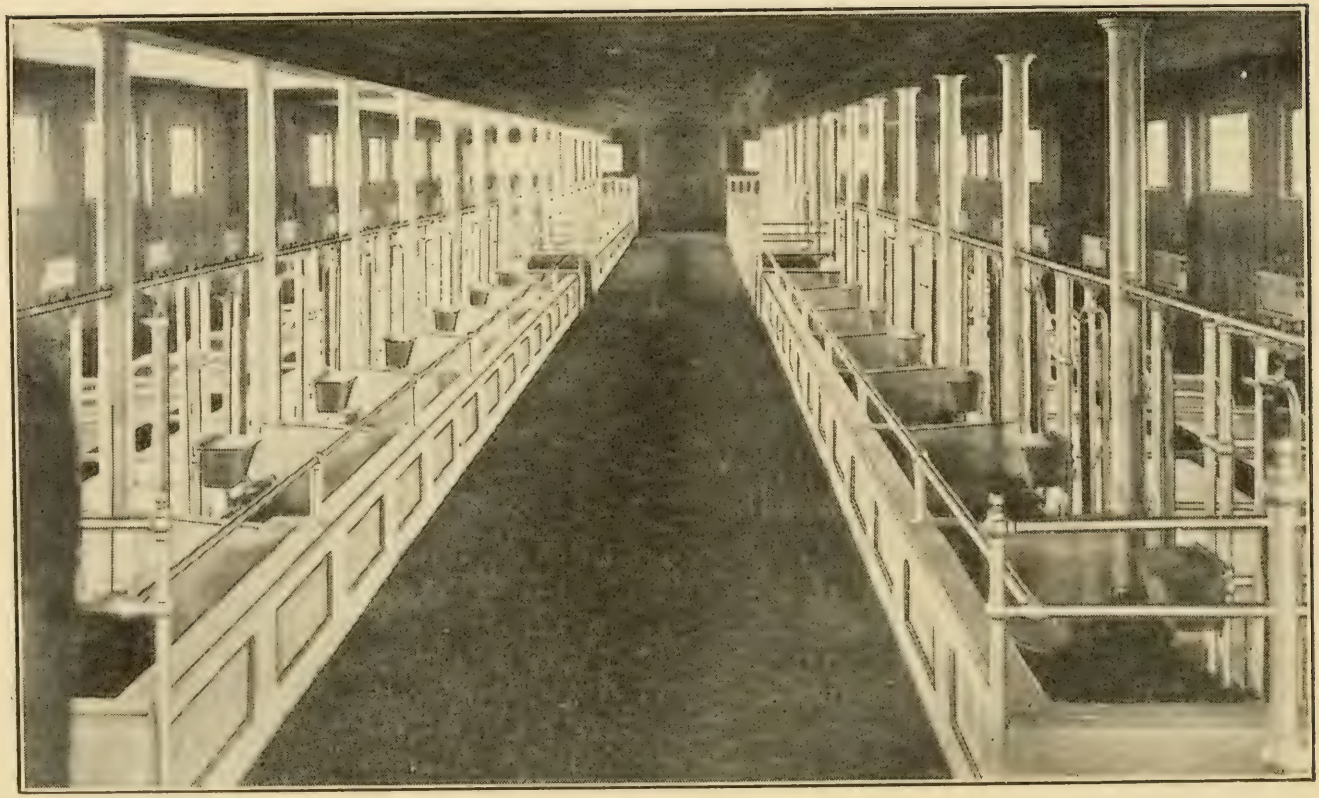
The following questions are the ones most generally asked by creamery patrons. These questions and answers are taken from Bulletin 181 of the Kansas Experiment Station and being in the form adopted in this Catechism they are commended.

261. Why was my test lower than last time?

Authorities have found that any of the following circumstances will cause the cream test to drop considerably:

(a) More water or skim milk than usual was used in flushing the bowl of the separator. The speed of the separator was too low.

(b) The separator was incompletely washed.



Inside of model dairy barn.

(c) The milk was allowed to flow into the separator bowl too rapidly.

262. Does sweet cream test the same as sour cream?

Yes. The amount of butter fat in the cream is not affected by souring, but cream in bad condition is more difficult to sample. The better the cream the more accurate the test will be.

263. How thick should I skim my cream?

As close as possible to 35 per cent.

264. What is the objection to a 25 per cent cream?

You give away too much skim milk, which is a good feed for young stock. Furthermore, a 25 per cent cream does not keep well.

265. What is the objection to a 45 per cent cream?

You cannot skim the thicker cream without losing a great deal of butter fat in the skim milk in the course of a year. There is also considerable mechanical loss from the amount of cream which adheres to the cans and utensils.

266. What is the best breed of cows to keep when cream is sold?

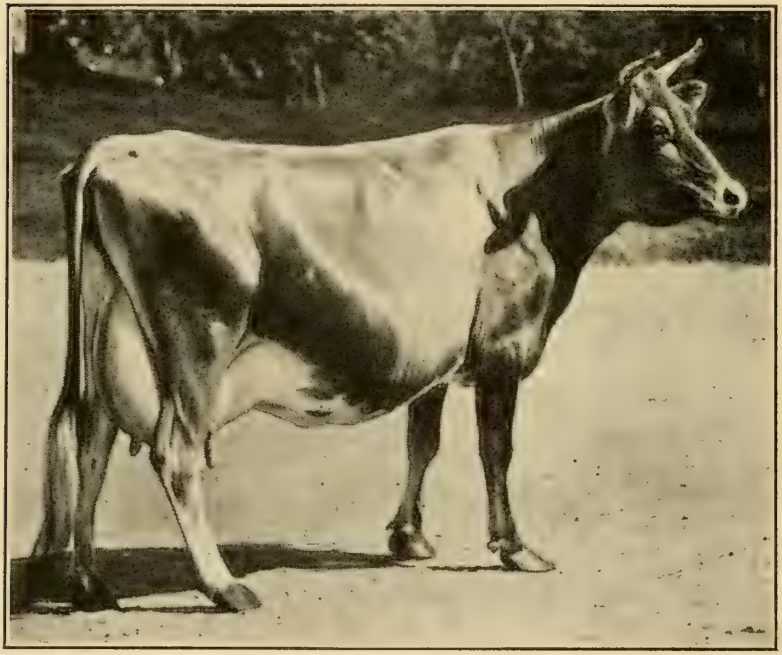
The Jersey, Holstein, Guernsey and Ayrshire are considered the best. Some strains of Shorthorns and Red Polls are also good.

267. What are the poorest breeds for dairy purposes?

All breeds which are raised chiefly for beef.

268. How can I tell my best cows from my poorest?

By weighing all the milk produced by each cow during the year and testing the milk for butter fat at frequent intervals.



Fine type of Jersey cow with a profitable record.

269. How much milk and butter fat should a dairy cow give in a year?

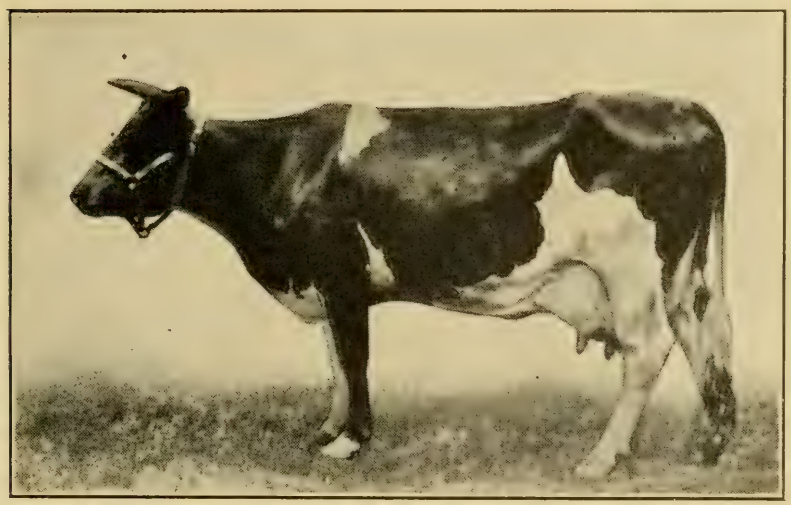
At least 6,000 pounds of milk and 225 pounds of butter fat. Under Kansas conditions a cow must give 4,000 pounds of milk or 160 pounds of butter fat to pay for her keep. The greater the amount above that the more profitable is the cow.

270. What is the world's record for butter fat produced by one cow?

At the present time it is 998 and a fraction pounds of butter fat in 365 days. This record is held by a Holstein cow.

271. Is that the highest record?

No. Since the Kansas Bulletin was published Banostine Belle De Kol, a pure-bred Holstein owned



Banostine Belle De Kol, a high-class dairy type Holstein cow.

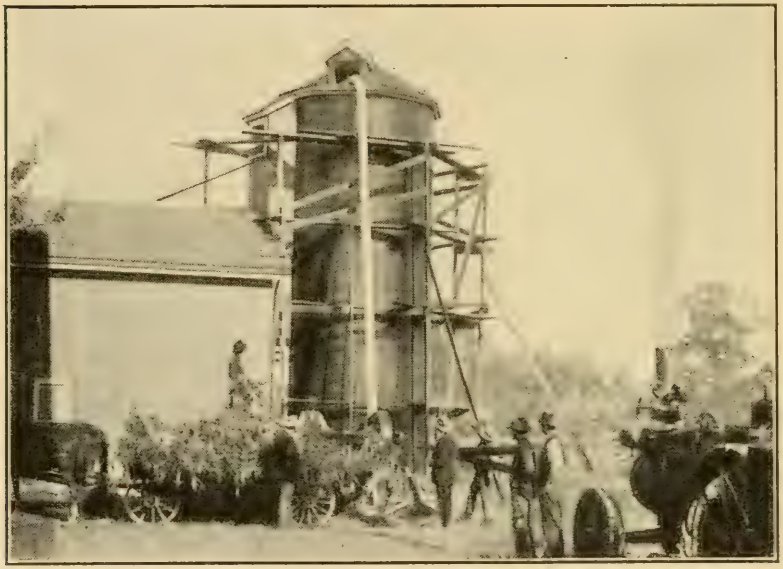
in Ohio, has become the "new queen of the dairy world." She produced in one year 27,404 pounds of milk testing 3.85 per cent butter fat. This is equivalent to 1,322.9 pounds of butter, or 3.5 pounds a day for 365 days. During the test silage and alfalfa were used nearly all the time.

272. Is the Babcock test always accurate?

Yes, if properly handled.

273. What protection has the patron against inaccurate tests?

All persons paying for cream on the basis of the Babcock test must first pass an examination and secure a permit granted by the state. Every operator is examined at least once every three years.



Filling a silo with corn.

274. What determines the price of butter fat?

The condition of the butter market is the chief factor. This is determined by supply and demand. No one can predict accurately what the butter market will be, but it is generally much higher in winter than in summer.

275. **Are silos a success and is silage a good winter feed?**

Yes, decidedly so, if the silos are properly made and filled.

276. **What is the best make of cream separator?**

The one which will skim the closest, last the longest, and be the easiest to clean thoroughly. Do not purchase one until you have investigated several makes and have had the agents give practical demonstrations. Inquire among your neighbors. Do not buy a separator entirely on the strength of an advertisement or on unsubstantiated claims.

277. **What place on the farm is the best for keeping cream?**

The coolest, cleanest place available. This is generally a spring house or a building provided with a tank of cold water changed frequently.

278. **Is not a cellar or cave a good place to keep cream?**

No. The air in a cellar or cave is seldom pure and the temperature is not low enough in summer.

279. **Where should a cream separator be kept?**

The separator should be kept in a separate room or building provided for the purpose. The building should be at least fifty feet from the stable and the yard where the animals are kept.

280. **How often should a cream separator be washed?**

The bowl and all parts of a cream separator which come in contact with milk or cream should be thor-

oughly washed and scalded after each separation. It is unlawful to use a dirty separator or dirty utensils.

281. What causes cream to become sour?

The action of bacteria. The souring of cream is delayed by keeping it clean and keeping it cold.

282. What are the chief causes of the bad flavors in cream?

Pastures containing strong-flavored weeds. Keeping cream in caves and cellars. Action of objectionable bacteria.

283. What is the best time of year for cows to freshen?

In October or November, provided the young calves are given adequate winter shelter. A cow freshening in the fall produces from thirty to forty pounds more of butter fat in a year than the same cow freshening in the spring. Moreover, most of the additional butter fat is produced when prices are highest.

284. Are creamery patrons ever dissatisfied?

Every creamery has a few patrons which continually are dissatisfied. The following remarks are given in this Kansas bulletin on dealing with such patrons:

285. How should dissatisfied customers be treated?

"Give him courteous treatment, but no favors.

"Refrain from arguing with him about his cream.

"Do not test a sample of his cream delivered else-

where unless you personally take a sample of his cream.

"Be frank and open with him and invite him to see his cream weighed, sampled, and tested in accordance with the rules of this bulletin."

VII. FARM MANAGEMENT

BUSINESS METHODS

286. How does agriculture compare with the other occupations?

Agriculture is the oldest of human occupations having been engaged in, in one form or another, from the beginning of the race. It is the most fundamental and important of all occupations and until recent years has made less progress than any other.

287. Why has agriculture progressed less rapidly than other occupations?

Mainly because it required less skilled labor and because the better educated and more ambitious people found more profitable and congenial employment in other and less slavish occupations such as law, medicine, theology, art, literature and commerce.

288. Have agricultural conditions changed in recent years?

Within the last century and especially the last half century, farm business methods have undergone many and radical changes. The old time farmer was truly a "Jack-of-all-trades." He was his own carpenter, blacksmith, tanner and shoemaker, while his wife and daughters manufactured the family clothing from raw material grown upon the farm.

289. What are some of the most important changes that have taken place?

Along with every other kind of business, the last few years have developed a decided specialization in farm labor, farm crops and farm methods. The modern farm has largely entered into the commercial life of the day, and recognized the advantages of division of labor and concentration of effort.

Filling the seed box preparatory to drilling wheat.

290. How do these changes affect agriculture?

Under this change farming becomes a business as well as an employment. It means the adoption of business methods in every department of the farm; the nice adjustment of capital, lands, tools, machinery, teams and equipment to each other; and a careful adjustment of the crops grown to the soil, climate and market to be supplied; keeping in mind

always the system of rotation to be practiced, and the class of labor available.

291. What are the most important causes of the changed conditions?

Undoubtedly the most important cause is the world movement in the direction of applied science, which is manifesting itself so strongly in every department of human endeavor. Agriculture was slow to feel its influence, but the advancement has been very rapid the last fifty years. In our own country the national and state departments of agriculture, agricultural colleges and experiment stations, farmers' institutes, the grange and a multitude of voluntary societies and associations have all added greatly to the general advancement.

CAPITAL

292. How many kinds of capital does a farmer use?

Two. Fixed or invested capital, as lands, buildings and equipment; and circulating or working capital—ready money for current expenses.

293. How should these different kinds of capital be adjusted to each other?

It is impossible to determine without knowing the conditions and kind of farming to be engaged in. The amount of land, buildings, teams, tools and labor should be so nicely adjusted to each other that one factor will not be insufficient for the greatest possible production and efficiency.

294. What is the effect of an intensive system upon the capital used?

Just as an intensive system of agriculture is substituted for a more extensive system, land improvement increases; better buildings are erected; silos, improved fixtures, and conveniences increase; better teams, better live stock and better equipment are manifest; more labor is employed and more money used in the business.

295. What effect has increasing population upon the capital invested in farming?

As the population increases the price of land goes up and the cost of production is increased. The quantity of land does not increase or decrease, and as the price of land goes up, better farming must inevitably be done upon it in order to pay dividends, interest and taxes. The increase in the price of the land benefits no one but the man who bought it at a lower price. As the population increases, while the acreage does not, each acre must be made to produce more in order to feed the people.

296. What proportion of the amount invested in land should be available for other purposes?

This will depend upon several factors, but as a general proposition not less than twenty-five per cent of the amount invested in the land should be available as working capital.

297. What are the most common financial mistakes of farmers?

Too much money invested in non-productive equipment; more costly residence and expensive

barns and other buildings than necessary; general failure to adjust investment to productiveness and efficiency. This is the cold-blooded side of it, but where the farmer has a surplus income he should delight to spend a reasonable part of it in improving and beautifying his home and farm.

LABOR

298. How much labor should be employed?

The size of the farm and the character of farming engaged in will largely determine how much labor may be profitably employed. Labor poorly or unprofitably employed is worse than inefficient labor. Much will depend upon the farmer himself and his skill in handling men and keeping them employed.

299. Why should farm labor be regularly employed?

The farm work should be so adjusted by rotation and diversified crops as to keep men profitably employed throughout the year.

300. How should farm labor be engaged?

All things considered, the regular hands should be hired by the year on the basis of so much per day. Instead of paying an average wage throughout the year it is better and safer to divide the year into three or four periods. If $1 a day is the average price agreed upon, better divide the year into three equal sections, and pay 75 cents, $1, and $1.25; paying least in the short winter months and the most when work is most urgent and there is most demand for men on the farms.

301. What is the chief advantage of this system?

In the winter when farm hands are not generally wanted they will stay contented at the lower price, while in the busy season, when farm labor is in demand and wages up, the man finds his wages so little below the current price paid that he stays contented where he is.

302. Which are most desirable, married or unmarried men?

For many reasons married men are to be preferred for regular farm labor. They are more to be depended upon, and much more likely to be efficient and contented.

303. What should be furnished farm laborers?

In addition to paying them regularly the wages agreed upon, if the man is married he should be furnished a comfortable, convenient house and a good garden, with permission to keep some chickens, a pig or two, and a cow.

304. What additional labor is necessary?

In addition to the one or more regular men employed who live on the place, it may be necessary at certain times and seasons to employ transient help. At such times there is no escape from utilizing such men as may be available, and less skillful men may then be utilized.

305. How may farm labor be kept profitably employed?

There is nothing that requires more forethought on the part of a farmer than to provide profitable employment for his farm hands every day in the

year, at all seasons and in all kinds of weather. This may be done by providing, as far as possible, work that may be done in the barns and buildings during inclement weather.

306. How should farm laborers be treated?

Farm laborers should, at all times, be treated with the greatest consideration and fairness. Abusive

A lot of high-class Champion Yellow Dent corn.

language should be scrupulously avoided and outbreaks of anger suppressed as far as possible. Courteous, careful instruction should be given, and appreciation of work well done always manifested. Every effort should be made to secure the confidence and cheerful co-operation of hired men.

Ability to keep them cheerful and contented is a valuable asset. A man should never be discharged in a fit of anger. If he proves unprofitable, inefficient or undesirable, quietly notify him that you do not need him any longer, and pay him off. It may be necessary to have him again some time.

IMPLEMENTS AND EQUIPMENT

307. What implements are necessary on a farm?

This question needs to be carefully studied by the farmer, and only such implements purchased as can be made to pay interest on the investment, cost of maintenance, of storage and wear and tear of the implement.

308. What class of implements should be purchased?

None but those best adapted to the work to be done under the conditions where they are to be used. Careful consideration should be given the power available and the size of the implement to be selected, which should be governed by the size of the farm and the amount of work to be done. A farmer with five acres of wheat to cut annually should not buy a binder; better hire one or cut it by hand.

309. What allowance should be made for depreciation of machinery?

Depreciation is a charge from which it is impossible to escape, though it may be very largely controlled by the care given farm machinery, and the kind of machinery used will have much to do with

it; but a fair average is ten per cent each year, to allow for depreciation on all farm equipment. The less complicated the machine, the less will be the depreciation.

310. How should farm machinery be cared for?

Every farm tool, implement or piece of machinery should be kept under shelter when not in use, and thoroughly painted once a year, both for the appearance and for the preservation of the implement. This painting can be done any odd time when the implement is not in use. Nothing gives surer evidence of thrift than the care given farm implements and equipment, including the barns and outbuildings.

CHOICE OF A FARM

311. What factors should determine the choice of a farm?

Much depends upon a wise choice of the farm. Location and character of the land are of first importance.

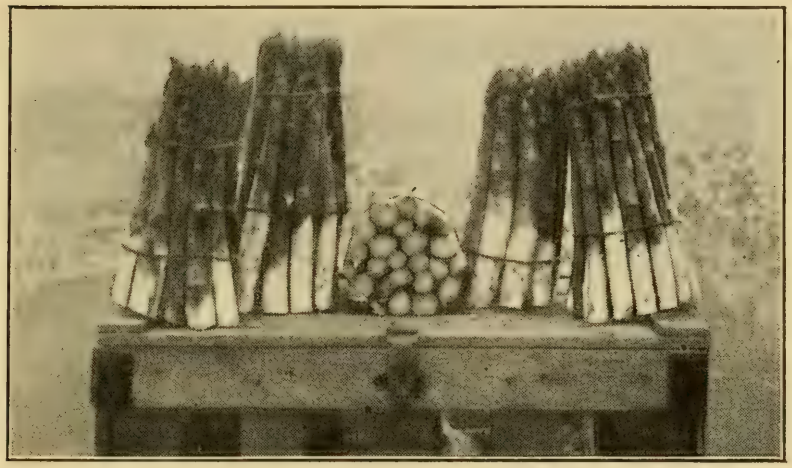
312. What are the controlling factors in location?

Surroundings generally, mail facilities, railway and trolley facilities, churches, schools, telephones, kind of neighbors, social opportunities, roads, markets and any other things that may add to or subtract from the locality as a desirable home for self and family.

313. What should be the character of the land?

Of first importance is the nature of the land, depending upon the character of farming engaged in.

The fertility or productive power of the land should be certainly ascertained. It is usually cheaper to purchase fertility in the land than in a fertilizer sack. The contour of the land should receive careful consideration—steepness, roughness, stoniness, dryness, wetness, etc. The proportion of waste land, buildings, water supply, woodland, orchards, fences and attractiveness of surroundings should be duly considered.



Green unbleached asparagus bunched for market.

SYSTEMS OF FARMING

314. What should determine the system of farming?

The system of farming should depend upon many things—personal likes and dislikes; adaptation of the land and climate; plan of rotation desired; markets to be supplied and labor to be employed.

315. What is special farming?

Special farming is the growing of a single crop or at most the growing of one main crop with one or two minor crops.

316. What is mixed farming?

As distinct from special farming, mixed farming is the growing of several crops of approximately equal importance, and usually includes the keeping of one or more kinds of live stock. It is sometimes called general farming.

317. What are the advantages of mixed farming?

Fertility more easily maintained; more sources of income; reduced risk of entire failure; better distribution of labor as well as diversity of interest.

FARM ACCOUNTS

318. Why should farmers keep accounts?

As a class of business men, farmers are probably less careful in keeping accurate account of their business than any other. In fact, accurate bookkeeping is of as much importance to a farmer as it is to any other business man.

319. What are the reasons for keeping farm accounts?

To avoid disputes, misunderstandings and loss; so that the farmer may know his business, and have the satisfaction and assistance such a record gives in conducting the business of the farm.

320. What system of bookkeeping should be adopted?

No particular system is necessary. The simplest method that can be adopted that will secure the desired result is best. Some knowledge of the general principles of bookkeeping is important.

Showing a large crop of cabbage grown under field cultivation.

321. What should the bookkeeping show?

It should show the amount of gain or loss in the business; where the gain or loss occurs; furnish a record of transactions; and guard against mistakes.

322. What is a single entry system?

It is a system where but one entry is made of the transaction. If John Doe buys a calf and does not pay for it, the amount is charged to his account.

If he pays for it, the amount is charged to the cash account. If the farmer buys a calf from John Doe and does not pay for it, he should credit John Doe with the amount, and if he does pay for it, the cash account should be credited with the amount.

323. What is double entry?

In double-entry bookkeeping, every entry is made in two accounts. In the case of John Doe above, his account would have been debited with $10 if he did not pay for the calf, and the account with live stock credited with the same amount. Later when John Doe paid the $10, his account would have been credited and the cash account debited with the amount.

324. What is an inventory?

An inventory is a list of all the property on hand at the beginning of the year, with a fair valuation attached to each item. In order to ascertain the gain or loss, it is necessary to take an inventory at the end of each year. Great care should be taken in fixing the inventory valuation. Due consideration should be given to any increase or depreciation in the value of each piece of property listed.

325. What kind of accounts should be kept?

Accounts should be kept with cash and persons, and separate accounts should be kept with live stock, dairy, poultry, orchard, garden and each field crop grown on the place, the number of accounts being determined by the extent and character of the business. All these accounts may be made as simple as possible, or developed into as elaborate a system as may be desired.

326. How should a farmer begin keeping accounts?

Begin as simply as possible and elaborate the system with practice and experience. Begin with the most important things, and extend the system gradually to include the less important.

327. What is the most important thing a farmer can do?

The most important thing a farmer can do may be summed up in two words—keep books.

328. How does education pay the farmer?

First—By increasing his earning power. The mind is master of the body; and the mind developed by education is better able to direct the body than the mind not so developed. The educated man knows his job, and does his work right the first time.

Second—By increasing his ability to choose and plan and direct. The leaders in agriculture are men of education. It must be so, because choosing, planning, and directing require thinking power. The educated man has been trained to think. He sees into his problem quickly, and solves it surely.

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